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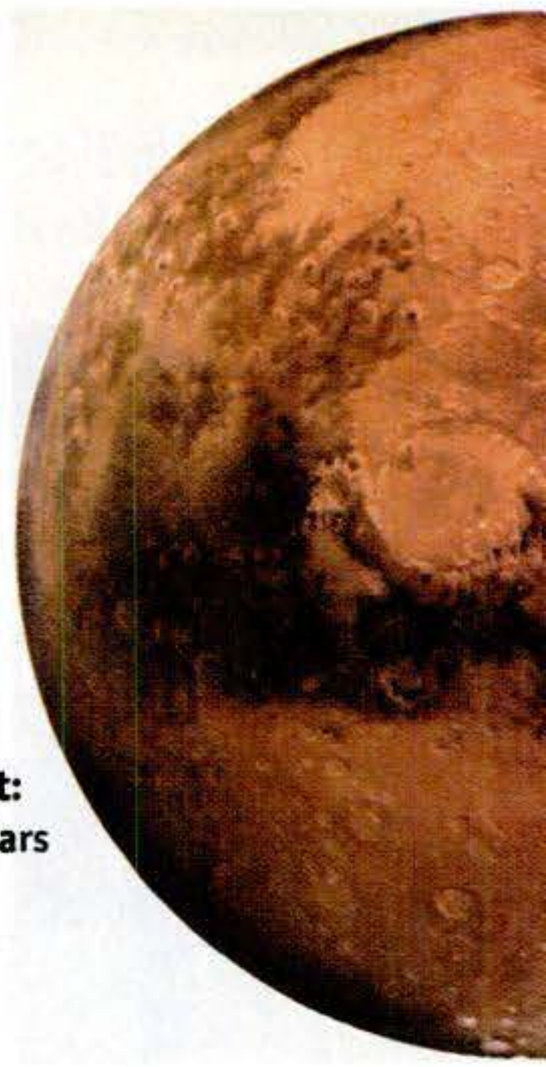

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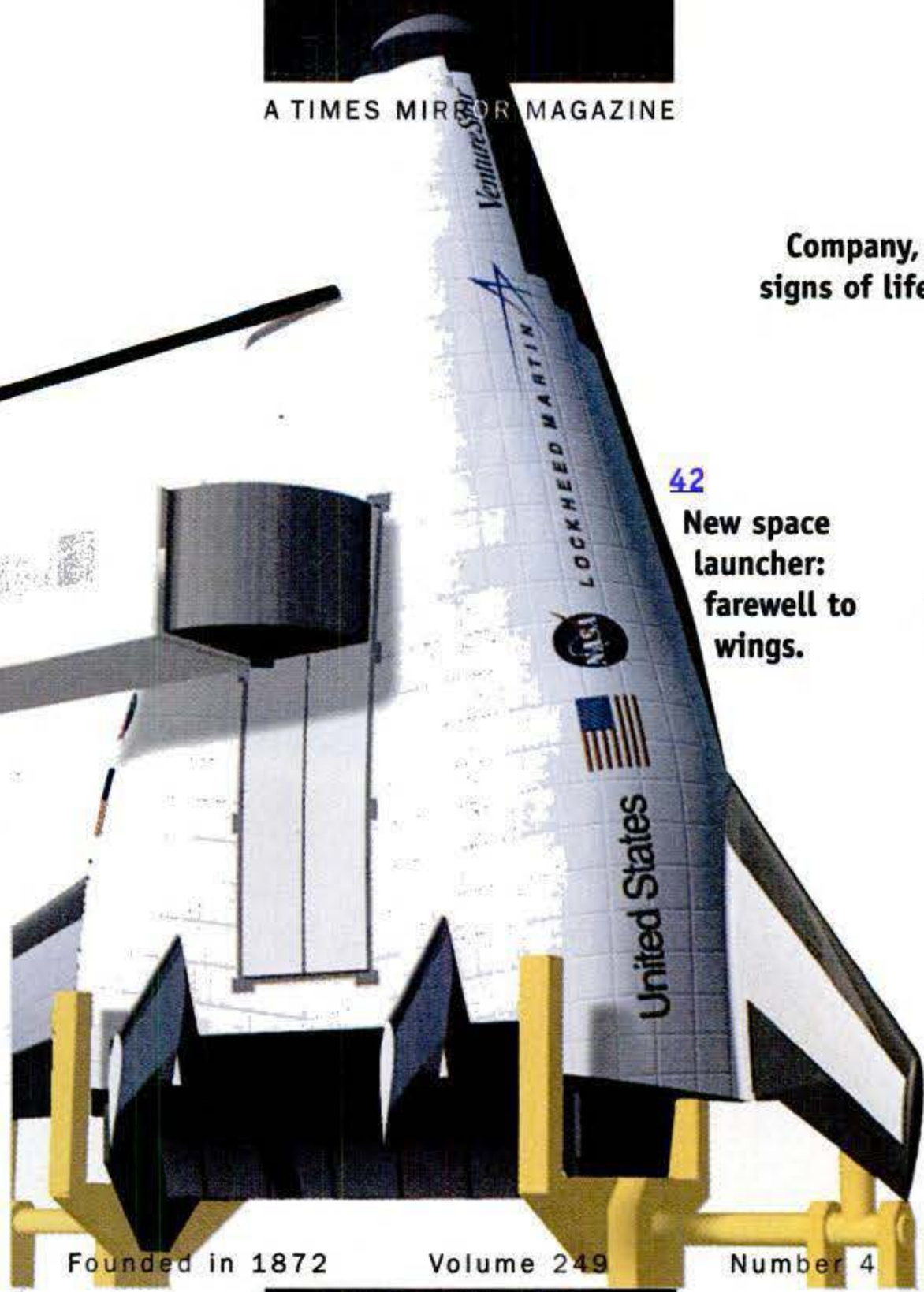

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Cover art by John Frassanito & Associates

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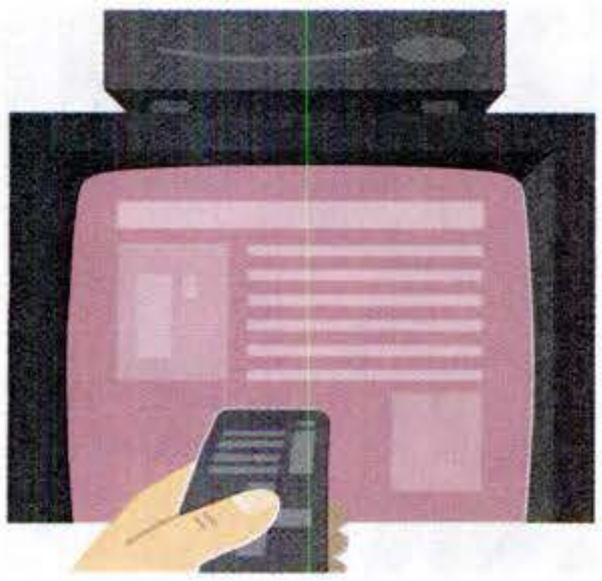

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At Last, Company

Hints of life on Mars

BY ANDREW CHAIKIN

REMEMBER WEDNESDAY, August 7, 1996. Remember where you were and what you were doing when scientists announced to the world that they had found signs of fossilized life inside a potato-size rock from Mars. The announcement was no quick-and-dirty speculation designed to grab headlines; it was the fruit of more than two years of painstaking detective work using state-of-the-art techniques. The scientists, led by geochemist David McKay of NASA's Johnson Space Center, have a reputation for meticulous work and conservative thinking. Even the skeptics had to admit that this time, it might not be a false alarm.

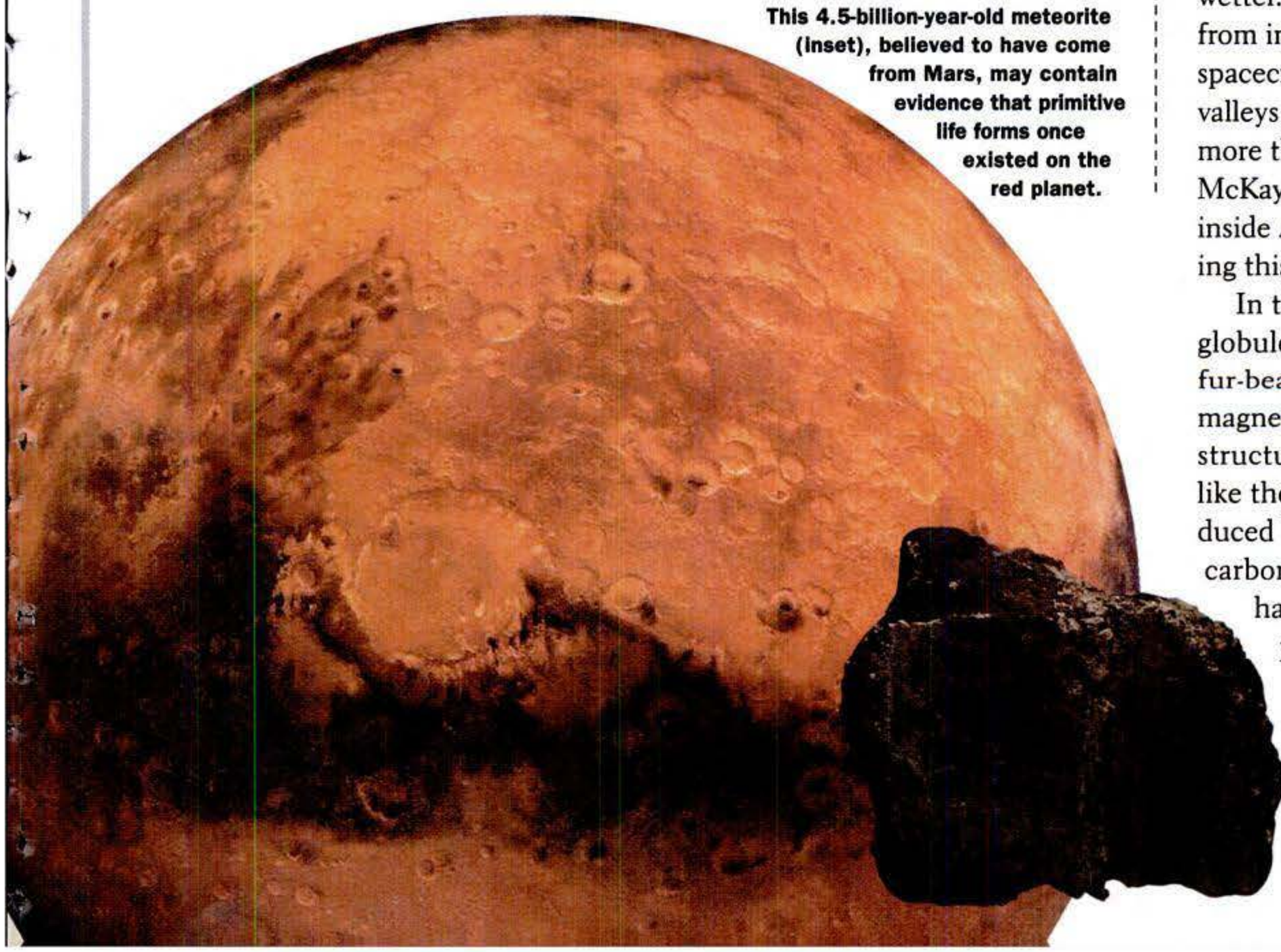
Twenty years ago, the Viking landers' failure to find martian microbes all but closed the door on speculation about life on Mars. More recently, scientists have given increasing consideration to the idea that life may have flourished on Mars long ago, when conditions were much less hostile. The latest discovery may support that theory.

To be sure, the findings are based on a host of unconfirmed conclusions, as the scientists themselves point out. No one can be completely sure that the rock, a 4.5-billion-year-old meteorite discovered on an Antarctic ice field in 1984, came from the red planet. But like 11 other meteorites identified by scientists since 1982, this one—officially designated ALH 84001—contains telltale chemical signatures consistent with a martian origin. Studies over the last decade have convinced many planetary scientists that these dozen rocks were blasted off the martian surface by meteorite impacts; then, over a period of millions of years, they found their way through space to Earth.

Even within this small group of martian meteorites, ALH 84001 is special. Within cavities inside the rock are tiny orange-brown globules of calcium carbonate, rare in meteorites but similar to terrestrial limestones. Forming limestones requires liquid water, and there is none of that on Mars today. But planetary scientists have long suspected that the planet was once far warmer and wetter. The best evidence comes from images sent back by orbiting spacecraft showing ancient, dry river valleys estimated to have formed more than three billion years ago. McKay's group believes the globules inside ALH 84001 were created during this ancient, watery epoch.

Even the skeptics had to admit that this time, it might not be a false alarm.

In the regions surrounding each globule are specks of iron- and sulfur-bearing compounds (including magnetite and pyrite) whose shapes, structures, and compositions are like those of terrestrial grains produced by biologic activity. Near the carbonate globules, the scientists have detected organic compounds—in particular, a class of molecules called polycyclic aromatic hydrocarbons, or PAHs. On Earth, PAHs can form in



This 4.5-billion-year-old meteorite (inset), believed to have come from Mars, may contain evidence that primitive life forms once existed on the red planet.

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the smoke from a candle flame or from a steak cooking on a charcoal grill, but the PAHs inside ALH 84001 most resemble compounds produced by the decay of simple organic matter.

These findings alone would have been remarkable. But the most stunning and controversial features are strange, tiny structures revealed in photographs made with an electron microscope. Some are pancake-shaped, others are tubelike and appear to be segmented; the largest is only one-hundredth the diameter of a human hair. They could be nothing more than mud cracks, but their sizes and shapes resemble those of terrestrial microbes. McKay's team believes they are the fossilized remains of ancient, single-celled martian organisms.

In isolation, any of the findings described above could be explained by processes having nothing to do with life, McKay notes. But the fact that they appear together, very close to one another, leads the team to conclude that they have discovered evidence that Mars was once alive. No evidence exists for any higher forms of life, but no one is complaining: Microbes will do.

The scientists are a long way from establishing proof, however. UCLA paleobiologist William Schopf has pointed out that more detailed studies are needed, to identify more of the strange microbelike structures and look for telltale features such as evidence of cell walls and signs of cell division. Ultimately, though, scientists will need to study samples brought back from Mars by spacecraft. NASA's new series of Mars explorations begins later this year with the launches of the Mars Global Surveyor orbiter and the Pathfinder lander and microrover; a sample-return mission could happen as early as 2005.

For now, the news of August 7 stands as the best piece of evidence so far for life beyond Earth. The skepticism of many scientists is only natural, given the enormity of what is at stake: Earth's uniqueness as a home for living things. If there were once microbes on Mars, then life may also have arisen on any number of worlds within and beyond our solar system. There could be a lot of company out there. ◆

Top: Orange-brown globules of calcium carbonate are similar to terrestrial limestones, which require liquid water to form. Bottom: Scientists led by NASA's David McKay believe these structures are the fossilized remains of ancient, single-celled martian organisms. The largest is one-hundredth the diameter of a human hair.

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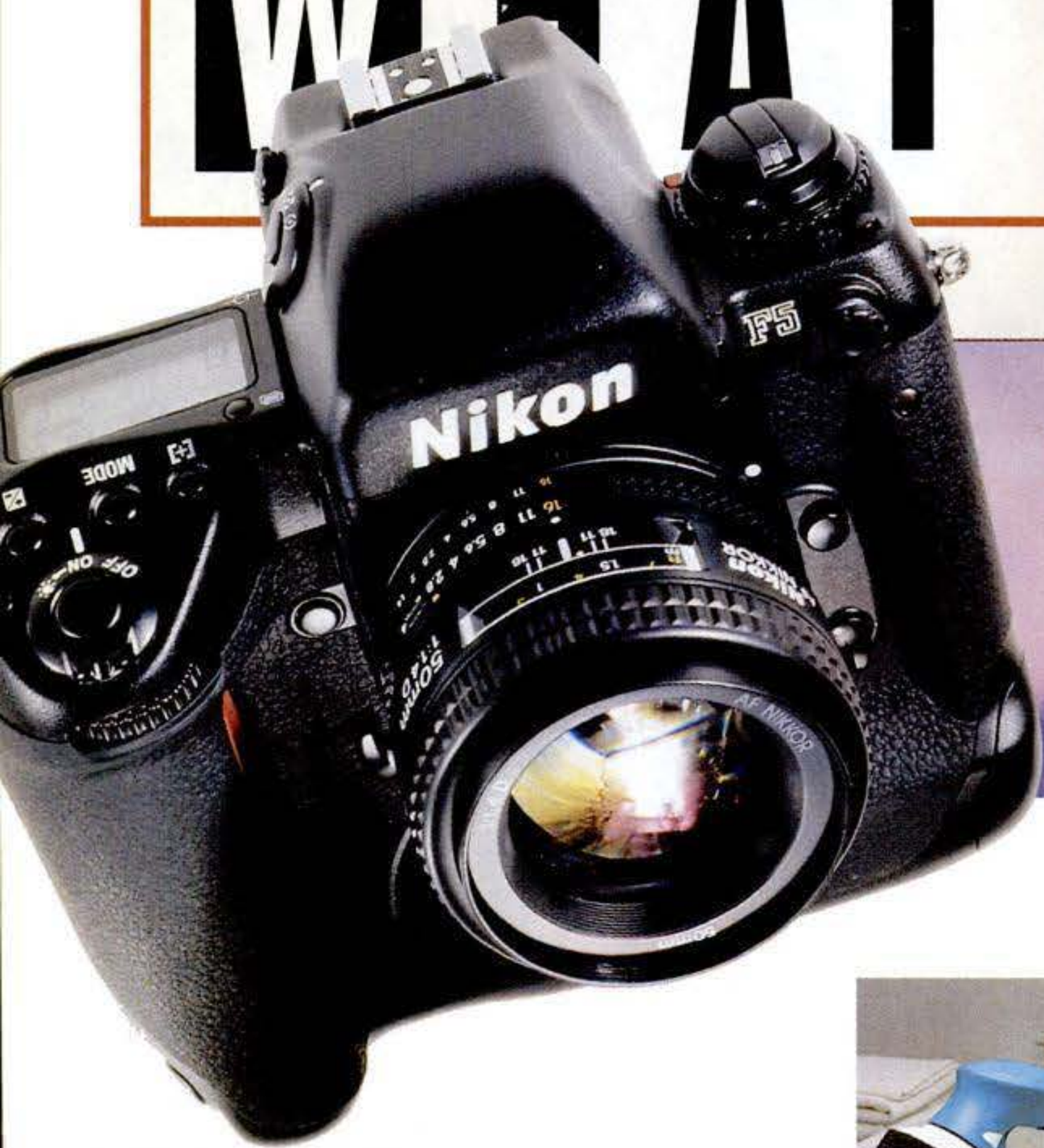
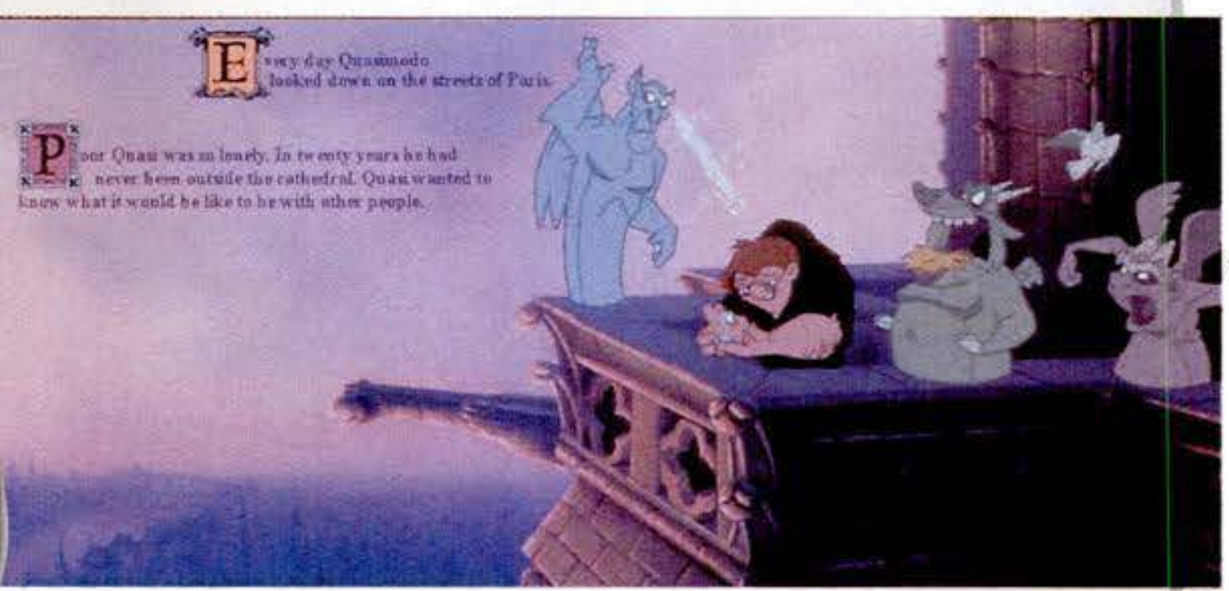




The CD of Notre Dame

DISNEY'S ANIMATED film has inspired a CD-ROM, Disney's Animated Storybook, The Hunchback of Notre Dame. Available this month for Windows PCs and Macs, the disc features interactive games and a 360-degree panoramic scene so kids can explore medieval Paris and the Festival of Fools. Price: $35. Disney Interactive, 500 S. Buena Vista St., Burbank CA 91521.

Champion SLR

NIKON'S F5 professional 35mm camera has arrived, and it was worth waiting for. Among its innovations are an autofocus system that lets photographers shoot up to eight frames per second with focus tracking—60 percent faster than current 35mm cameras; the 3D Color Matrix Meter that for the first time incorporates color information into the exposure; the first adjustable center-weighted meter for choosing the size of the center circle sensing area—either 8mm, 15mm, or 20mm; and a shutter that automatically adjusts shutter speeds. Price is not yet set.

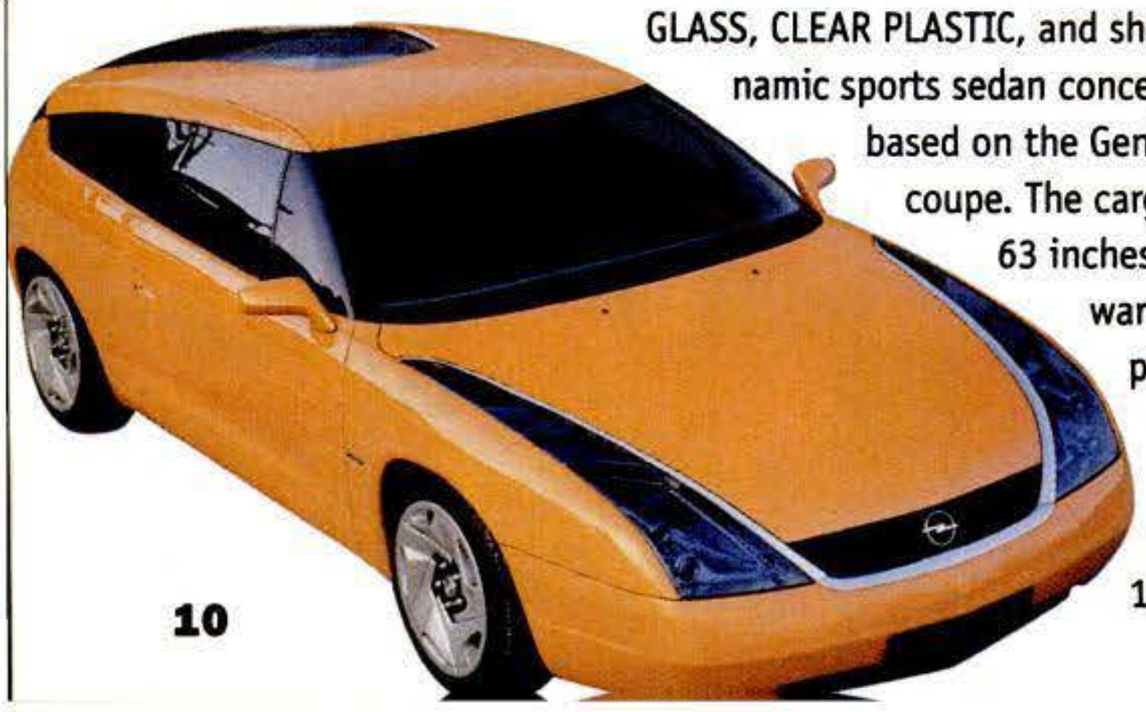
Scrub-a-Dub

RUBBER DUCKY, move out of the way. Black & Decker's new Scumbuster cordless scrubber can scrub your tub for as long as 25 minutes with a single rechargeable VersaPak battery. Attachments include a scouring pad, a scrub brush, and a detail brush. Price: about $60. Black & Decker, 6 Armstrong Rd., Shelton CT 06484.

Line of Light

THE LIGHTLINE 360 is a portable lighted rope for use by firefighters, utility personnel, and search-and-rescue workers. The waterproof rope contains thousands of tiny incandescent bulbs embedded in a plastic that's resistant to heat up to 450°F. The rope comes in 100-, 200-, or 300-foot lengths, which use from 4.5 to 14 amperes of power and weigh from 12 to 36 pounds. Price: about $12 per foot. FlexLight, 102 Fernwood Ave., Edison NJ 08837.

Sporty Concept



GLASS, CLEAR PLASTIC, and sheet metal flow together for a dynamic sports sedan concept called the Bertone Slalom, based on the General Motors Opel Calibra 4x4 coupe. The cargo area extends from 40 inches to 63 inches when you slide the back seat forward on guide rails. The Slalom is powered by a turbocharged 2-liter 16-valve engine developing 204 hp. Carrozzeria Bertone S.p.A., Corso Canonico Allamano 40/46, 10095 Grugliasco, Torino, Italy.

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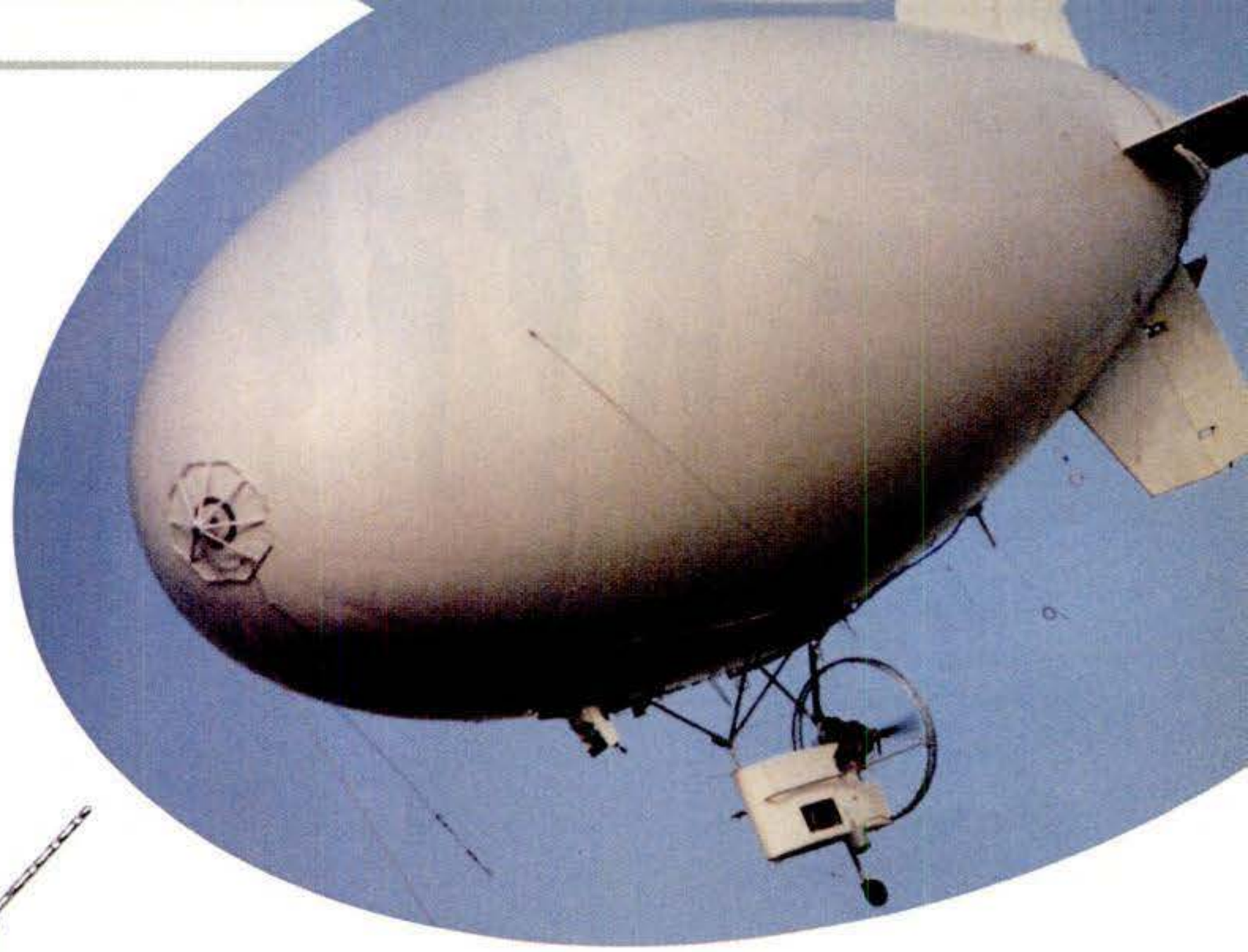
New Look

IF YOU THINK YOU know the look of the Bose bookshelf speaker line, look again. The 301 model has been retooled (cover removed to show, above), although some aspects remain unchanged: The off-angled tweeter still delivers the distinctive Bose spatial-separation sound. Price: about $370 per pair. Bose Corp., The Mountain, Framingham MA 01701-9168.

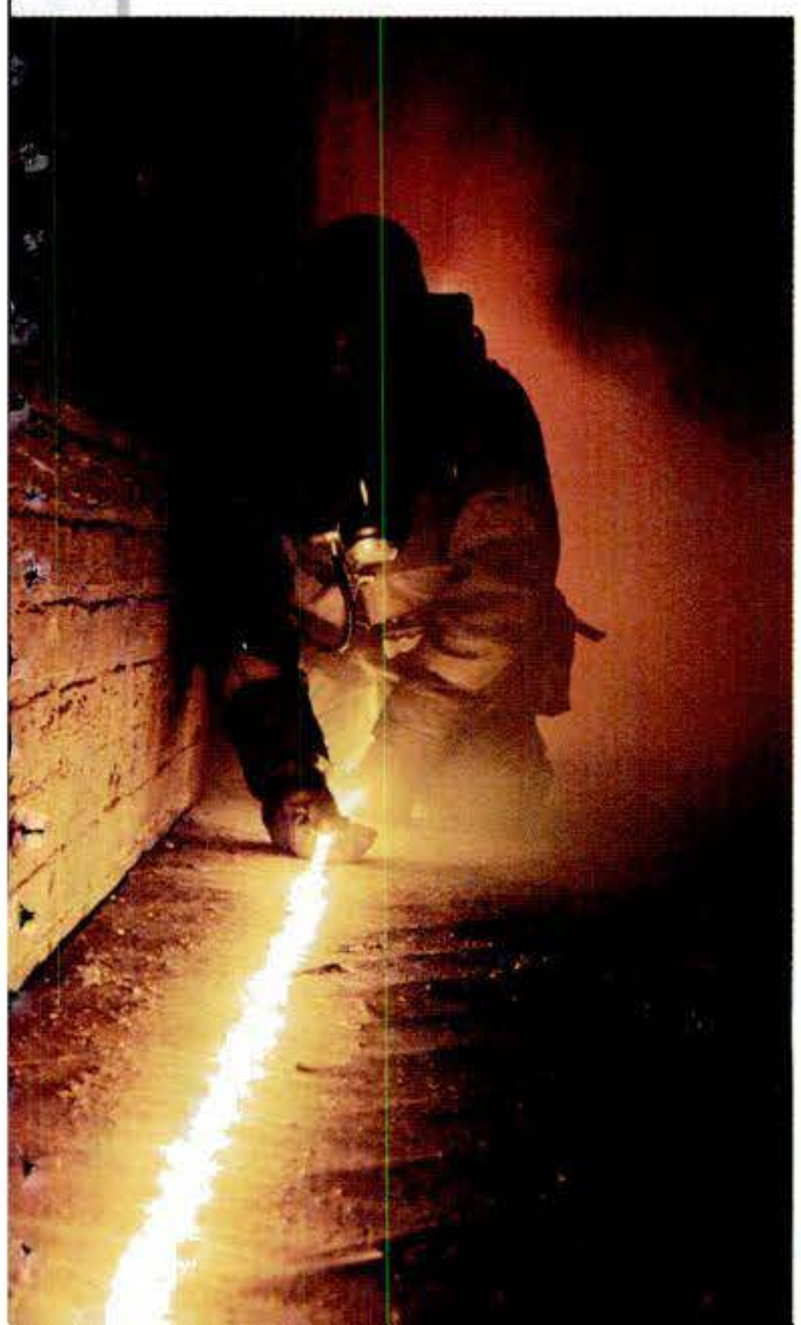


Envisioning Drills

WHAT SORT OF woodworking tools will the next generation of consumers use? Black & Decker enlisted industrial design students at the University of Wisconsin-Stout to hypothesize some answers. Many of the students created prototype drills that better conform to a user's hands and are lighter in weight than today's models. One (shown) features a movable hand grip, so that it can be used both as a screwdriver and a pistol-grip drill.

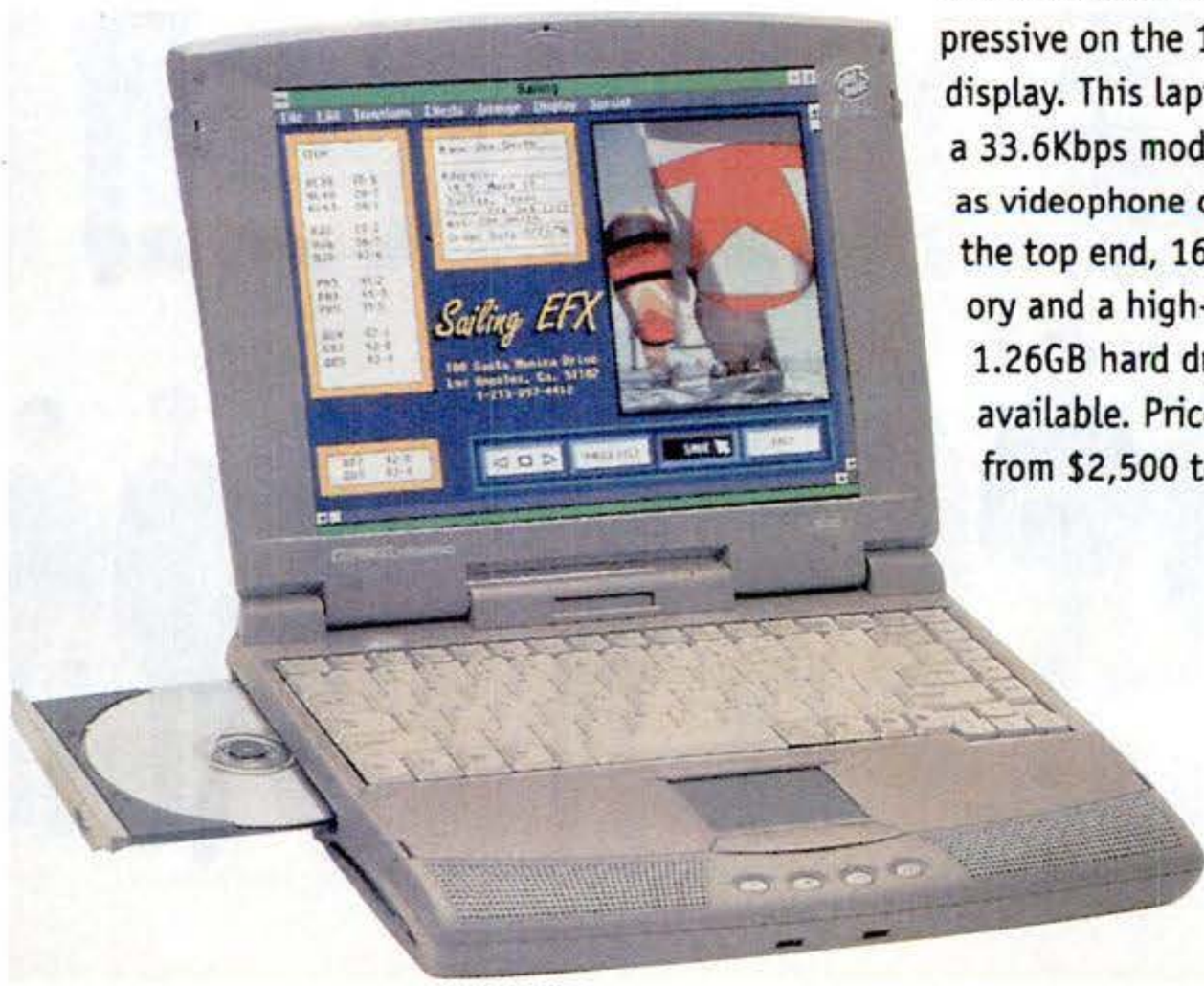
Portable Airship

THE U.S. ARMY has used an unmanned airship called SASS LITE (Small Airship Surveillance System, Low Intensity Target Exploitation) since 1989 for border patrols and other missions. Now a SASS LITE-class airship outfitted with a TV camera instead of a military payload will fly commercially, says Bosch Aerospace of Huntsville, Alabama. Unlike manned blimps, SASS LITE airships are portable: One of the 90-foot-long crafts could cover an event and then be shipped to do another.



Sound Moves

A LAPTOP COMPUTER that sounds good? The Compaq Presario 1000's stereo sound makes using the laptop's built-in CD-ROM player a pleasure, and full-motion video is impressive on the 11.3-inch display. This laptop also has a 33.6Kbps modem as well as videophone capability. At the top end, 16MB of memory and a high-capacity 1.26GB hard drive are available. Prices range from $2,500 to $4,000.



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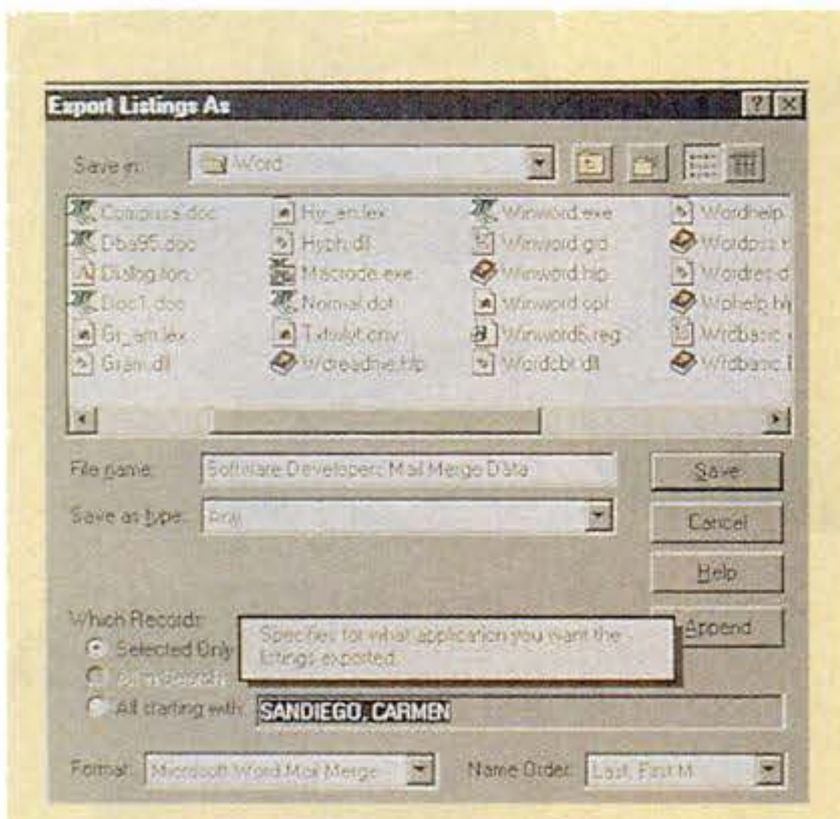
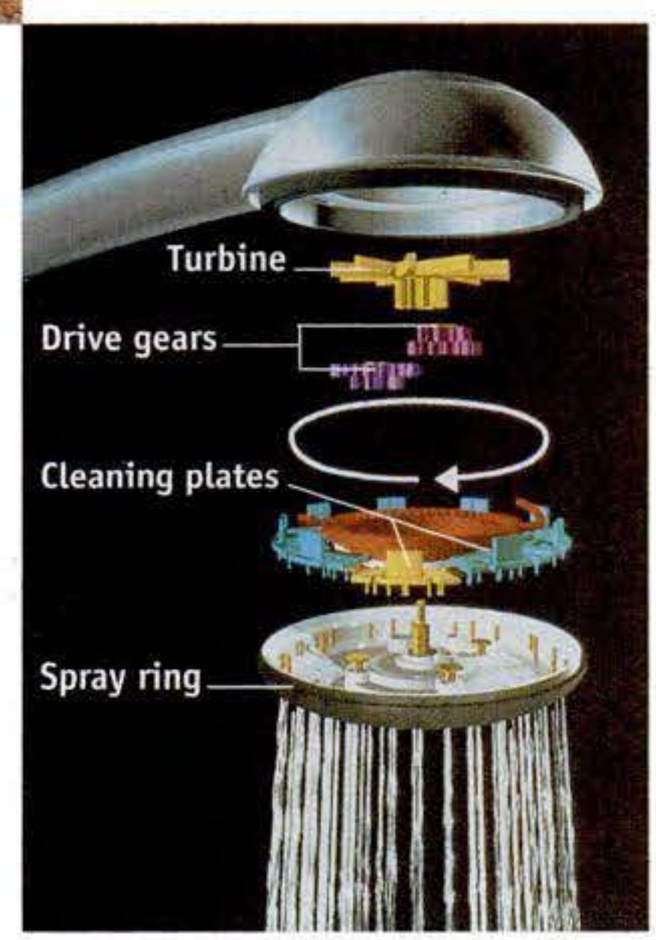
World Bike

A WINNER IN the Global Design Challenge, this bike, designed by two French students, has only four principal parts. It would cost about $100 to make, and it fits 95 percent of the population. Its automatic transmission is radically simple: Composite spirals that anchor a rubber belt compress and expand to match the pressure applied to the pedal, increasing or decreasing the power per cycle. While contest sponsor Owens Corning will not be manufacturing any of the winners, it's likely that someone will.



DVD Dialing

THE DVD-ROM ERA officially begins with PhoneDisc PowerFinder USA One, a national telephone directory on a disc. PhoneDisc is the first title produced for the new DVD-ROM format—essentially it's a high-capacity CD-ROM. The PhoneDisc DVD stores 122 million listings (3.7GB of data) on one disc; the CD-ROM version ($TK), requires six to store the same information. The release of PhoneDisc's DVD edition awaits the availability of DVD-ROM drives. [see Electronic Newsfront]. Digital Directory Assistance, 6931 Arlington Rd., Ste. 405, Bethesda MD 20814.



Showerhead, Clean Thyself

THE AKTIVA CARESSE from Hansgrohe is a hand-shower that cleans itself as you shower with it. Water drives the gears of its turbine, the gears push pins, and the pins clean the nozzle channels. Available in chrome, polished brass, and other finishes. Prices range from $130 to $210. Hansgrohe, 1465 Ventura Dr., Cumming GA 30130.

Computer for Gamers

FOR SERIOUS PC GAMERS LOOKING for fast action, the Compaq Presario 8000 series offers 6MB of RAM for graphics alone. The total memory ranges up to 32MB and the hard drive is a whopping 3.8GB. Other speedy features: Intel processors blaze away at up to 200MHz, a DSVD modem sends voice and data simultaneously, the 8X CD-ROM drive offers fast access, and a 12-function programmable game pad speeds play. A JBL audio system offers high-fidelity sound. Prices range from $2,500 to $3,200.

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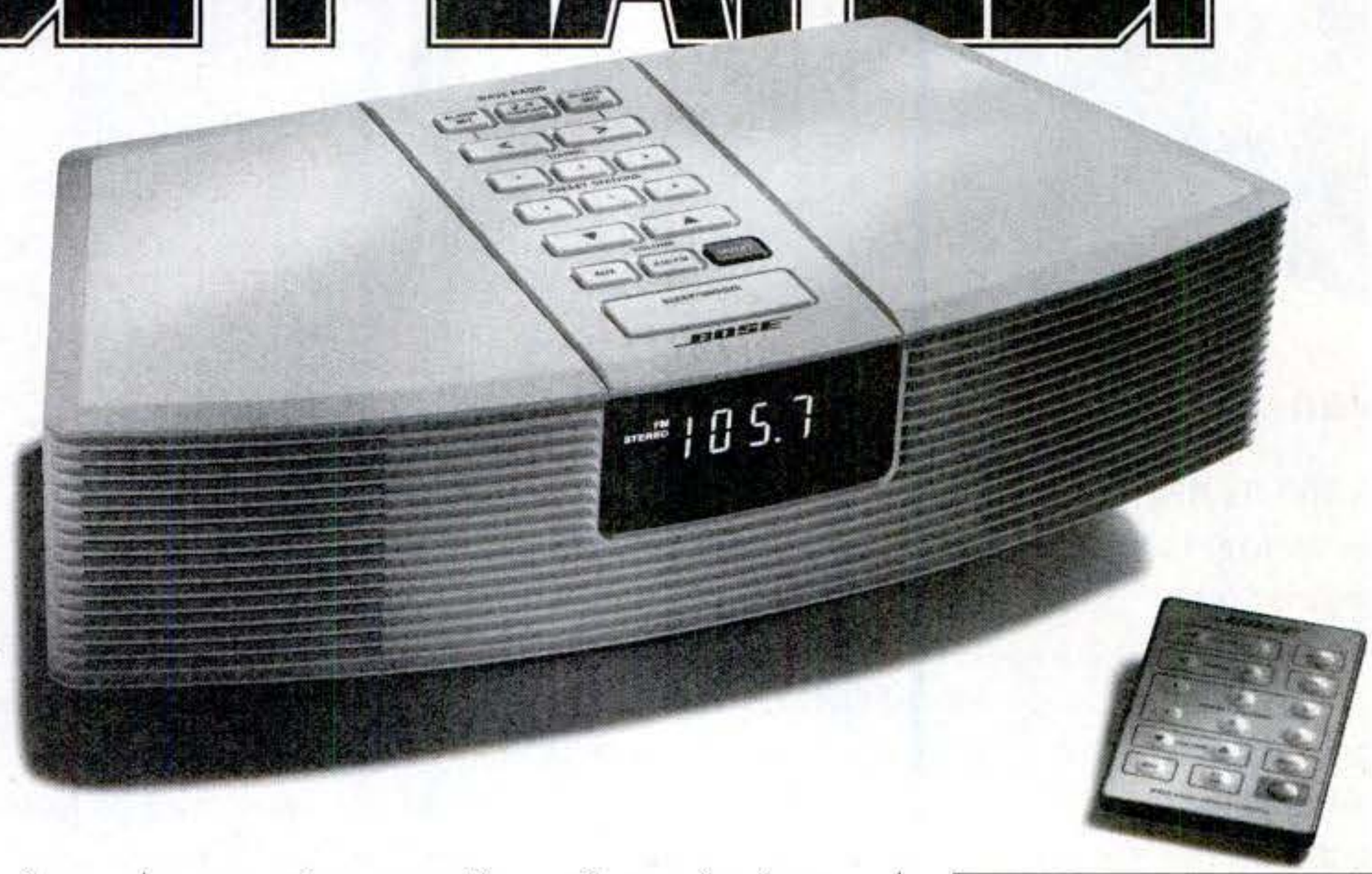
HEAR THE GAME THE WAY IT WAS MEANT TO BE PLAYED.



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Going With the Floe

BILLED AS THE ONLY facility in the world that gives the public a peek at sea ice from the underside, the Okhotsk Tower sits off Mombetsu, a town on the northeastern tip of Japan's northernmost main island of Hokkaido. The tower is half a mile offshore in the Sea of Okhotsk. Its observation decks for tourists and facilities for researchers are both above and below the sea ice, which extends to the site for two months each winter.

Talk and Watch

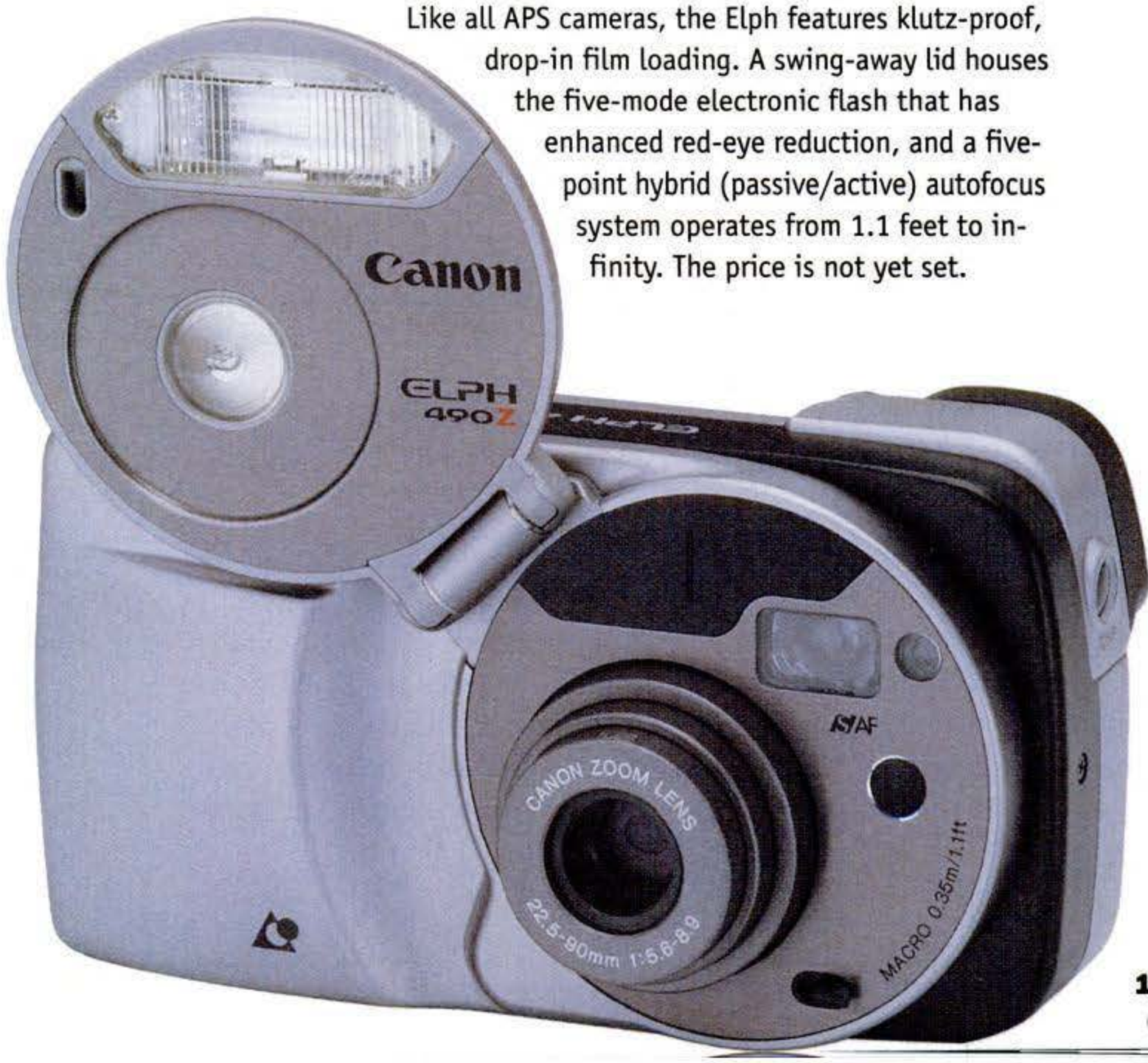
YOUR FAVORITE COUCH potato just may transform into a telephone hog as well with Remote-N-Phone, a combination TV remote and cordless phone. It features a nine-number memory, low-battery alert, and universal TV-remote compatibility. The recharging unit can also send out a signal to find the handset. The price is about $140. G-tel, 6625 Calle Eva Miranda, Irwindale CA 91702.

Family Van

RENAULT SHRINKS its MPV (Multipurpose Vehicle) to create the Megane Scenic. Only 13.5 feet long, it has a split-level floor that is higher in the back for extra storage beneath. A "family flexible" layout seats five; come mealtime, the front seats swivel to face rearward, while the center seat folds to become a table for four. The front-drive Scenic has four engine options, for up to 150 horsepower. Renault, 34 qui du Pont-du-Jour, 92109 Boulogne-Billancourt, France.

Baby Zoomer

THE CANON ELPH 490Z, NEWEST ADDITION to the slowly expanding APS (Advanced Photo System) family of cameras, combines the convenience and portability of the APS with a remarkably compact 4x (22.5 to 90mm) zoom design. Like all APS cameras, the Elph features klutz-proof, drop-in film loading. A swing-away lid houses the five-mode electronic flash that has enhanced red-eye reduction, and a five-point hybrid (passive/active) autofocus system operates from 1.1 feet to infinity. The price is not yet set.



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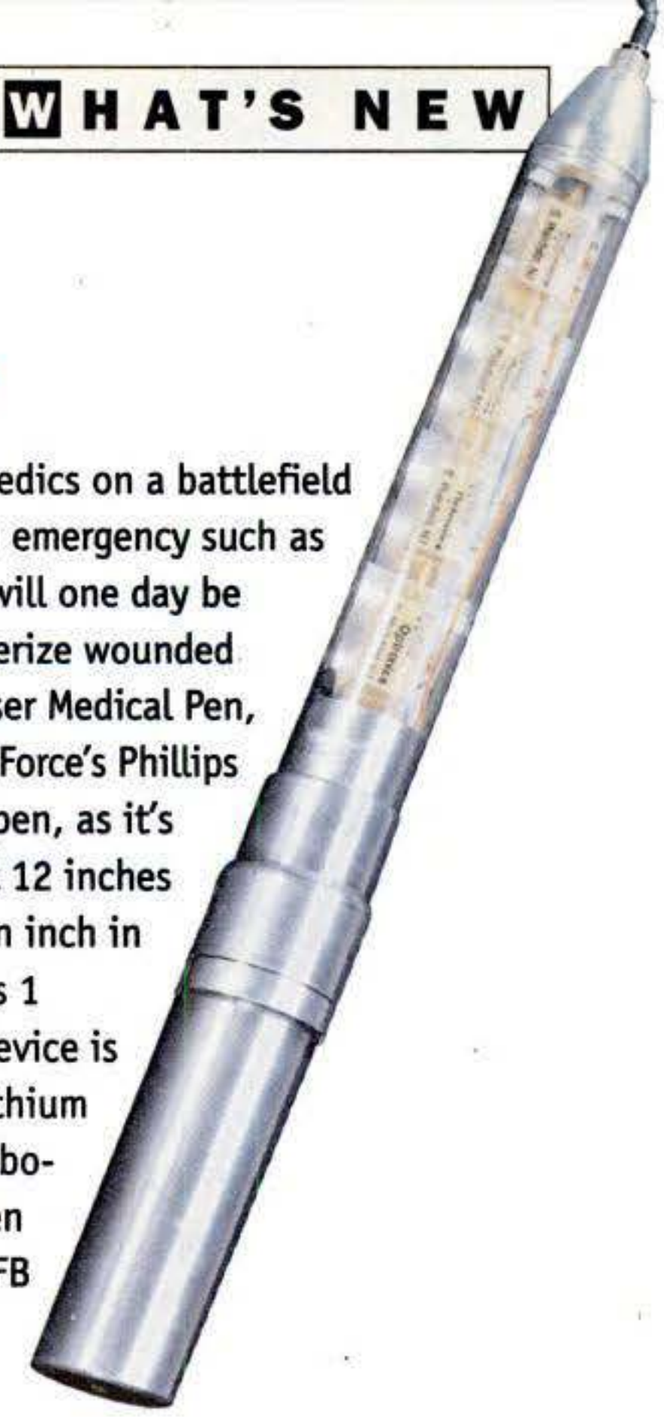
In the Labs

EVER WISH you could have been a fly on the wall of Thomas Edison's laboratory? InventorLabs may be the next best thing. Using QuickTime VR (virtual reality) technology and authentic films and sound recordings, this CD-ROM lets you explore the labs and experiments of Edison, Alexander Graham Bell, and James Watt (inventor of the steam engine). Each lab has a do-it-yourself experiment, too. The Mac/Windows hybrid disc sells for $50, from Houghton Mifflin Interactive. Houghton Mifflin Interactive, 120 Beacon St., Somerville MA 02143.

Wound Fixer



DOCTORS AND paramedics on a battlefield or at the scene of an emergency such as a highway accident will one day be able to cut and cauterize wounded patients with the Laser Medical Pen, developed by the Air Force's Phillips Laboratory. The Medpen, as it's also known, is about 12 inches long and less than an inch in diameter, and weighs 1 pound. The 5-watt device is powered by 3-volt lithium batteries. Phillips Laboratory, 3550 Aberdeen Ave. S.E., Kirtland AFB NM 87117-5776.

Suspension of Disbelief

WANT A SMOOTH RIDE in any snow condition? Just flip a switch on the dashboard of the 1997 Ski-Doo Grand Touring SE snowmobile, and on the fly you'll adjust a high-performance rear suspension system for different loads or trail types. The switch operates an air compressor that corrects the air pressure in the shock. The sled also features an electronic primer for easy start-ups and a digital engine-data recorder for diagnosing any operating problems. Price: around $8,800. Bombardier Motor Corp., Box 8035, Warsaw WI 54402-8035.

Roller Mouse

THE GRAY BUTTON in the middle of Microsoft's IntelliMouse clicks like a regular button and scrolls like a wheel. The rolling action lets you move line by line—or page by page—through a document, zoom in on specific cells in a spreadsheet, or flip back through cached Web pages. Price: $79. Microsoft, One Microsoft Way, Redmond WA 98052-6399.

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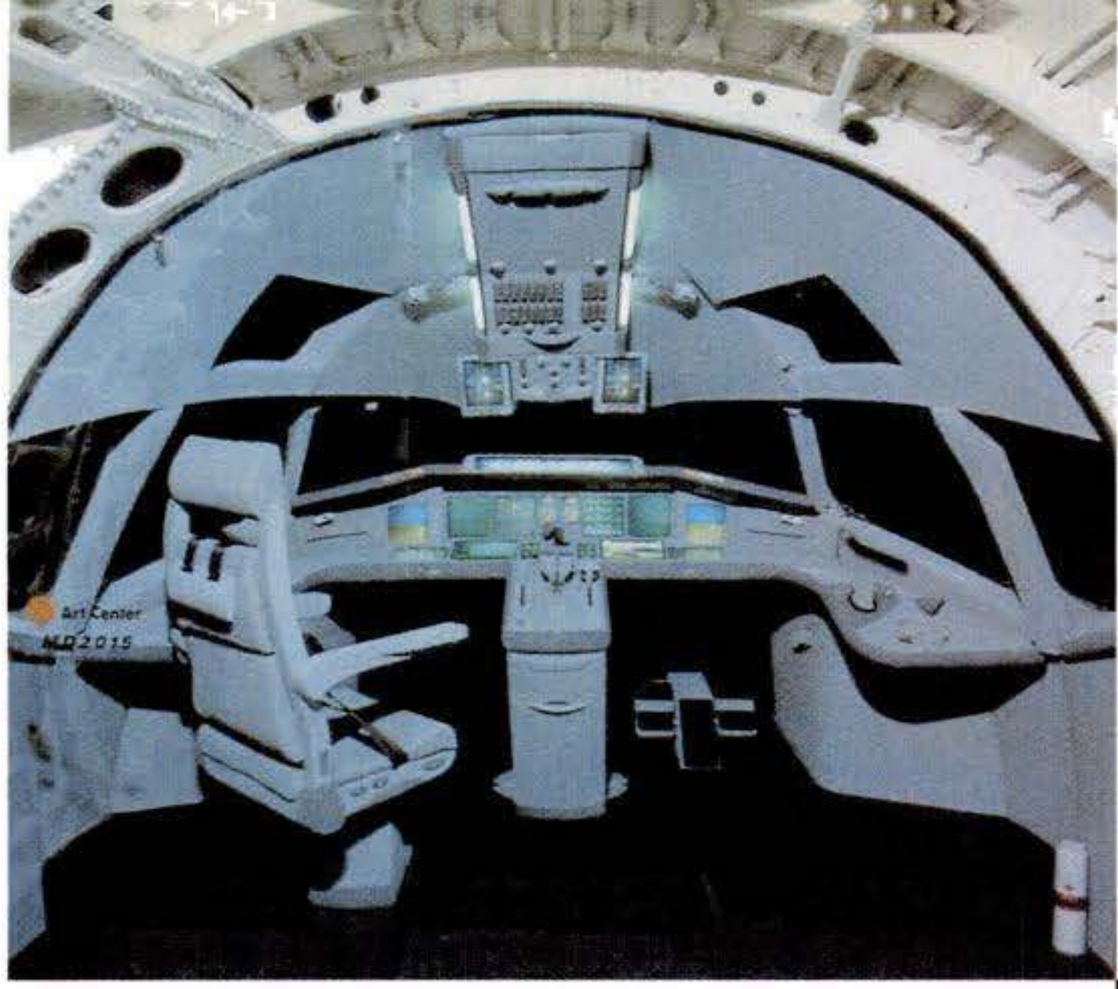
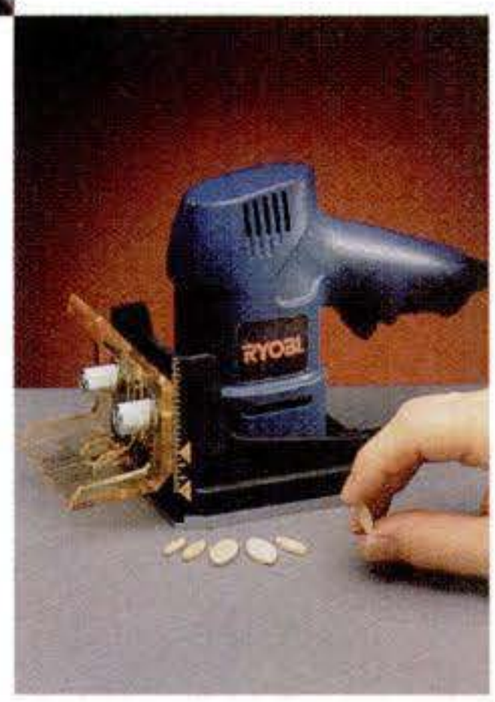


Future Cockpit

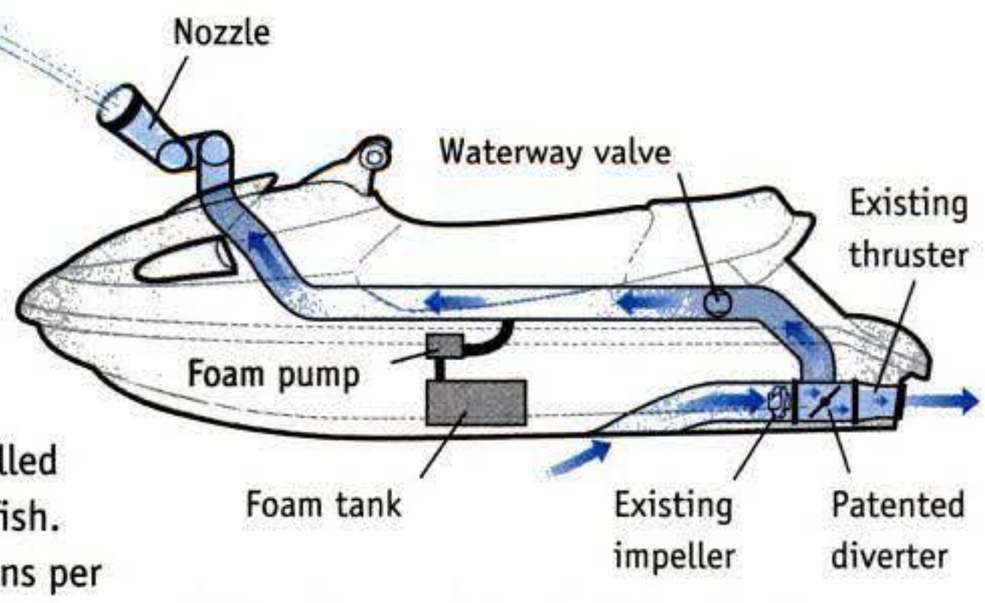
WHAT WILL AIRLINE COCKPITS of the future look like? As envisioned by students of the Art Center College of Design, they'll be less cluttered. Developed at the behest of aircraft maker McDonnell Douglas, the features include touchscreen multifunction displays that replace individual dials and controls, and head-up displays. No plans exist to put these blue-sky concepts into production, but they are technically feasible. Art Center College of Design, 1700 Lida St., Box 7197, Pasadena CA 91109-7197.

In the Frame

WITH PRECISION woodworking—small-scale miter joints for tiny picture frames or decorative boxes, for example—most biscuit joiners are too large, and nails or staples aren't always practical. What to do? Use the tiniest of biscuits with the first tool designed to handle them: Ryobi's Detail Biscuit Joiner (Model DBJ50) with new Accu-Biscuits, available in 5/8-, 3/4- and 1-inch sizes. A see-through fence lets the user cut with accuracy. The Detail Biscuit Joiner should sell for about $70 when it is introduced this month.



GREG MAXSON



Fire Killers

THE SMALLEST jet-propelled fireboats are the Archerfish. They can blast 400 gallons per minute; flows of 1,000 gpm are possible when supplying land-based operations. A diverter valve shunts water from the rear of the boat to the front; the firestream of water will reach distances of 80 to 130 feet. Prices start at $24,000. Katydid Specialties, 1501 Allens Lane, Evansville IN 47720.

It's So Small

OKIDATA'S incredibly small Okipage 4w personal laser printer—roughly the size of a toaster oven—has a petite price tag to match: $299. And although it's the smallest and least-expensive laser printer for the PC to date, it prints just like a 600-dpi model at a respectable four ppm. Okidata, 532 Fellowship Rd., Mount Laurel NJ 08054.

Roadster with Cockpits

THIS ROADSTER WITH INDIVIDUAL cockpits for driver and three passengers is a road-going concept. Running boards and rollbar handgrips ease step-over access to each seat, since there are no doors. Based on a front-drive Fiat Brava platform, the car has a 100-inch wheelbase and 145-hp five-cylinder engine. The upper body is removable; the company is aiming at a niche market for off-the-shelf customized cars. ItalDesign SpA, Via A. Grandi 11, 10024 Moncalieri, Torino, Italy.

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NEWSFRONTS

HOME TECHNOLOGY

EDITED BY JUDITH ANNE GUNTHER

BUILDING TECHNOLOGY

A Cubist's Idea of Home

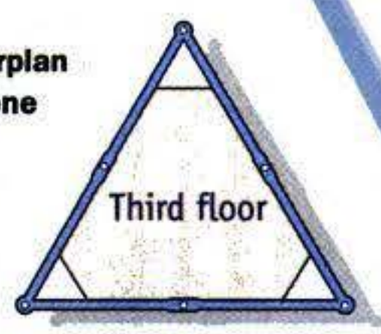
YOU MIGHT mistake it for modern sculpture, but a trio of giant steel cubes has a more practical purpose: to demonstrate that housing can be built anywhere. Located in Toronto, the cubes are being erected on a cramped site that's a floodplain, next to an elevated Toronto highway, and near contaminated soil.

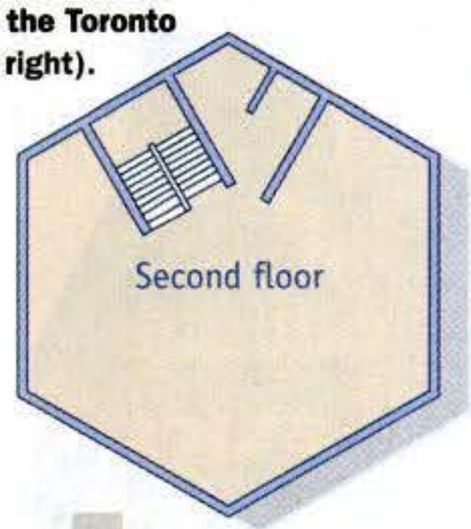
Each three-story cube consists of a prefabricated steel frame, 24-feet-long on a side, that's covered with sheet metal. Tilted up so that one corner points skyward, each cube rests on a 18-foot-tall steel column. This elevated building concept can make use of small, environmentally challenged urban lots that are traditionally spurned by developers, says Ben Kutner, president of UniTri Technologies of Toronto, who adapted the design from a Dutch building.

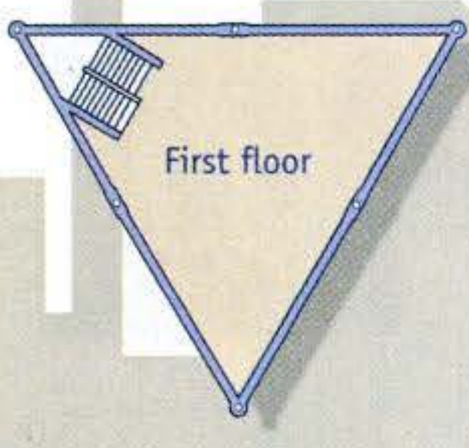
The unique design also uses building materials efficiently. For instance, who needs a peaked roof for shedding rainwater when the structure already is sloped? Because the cubes are bolted together for additional support, a large foundation isn't necessary: Instead, the steel columns extend approximately four feet into the soil. And windows within the angular walls provide great views of the street and sky.

Depending upon the use of the blocky building, Kutner says the open space between the cubes could be enclosed to house elevator shafts and heating, water, and ventilation pipes, as well as a lobby.

—*Robert Burg*







An angular floorplan (right) is just one characteristic of this blocky design. Three cubes, clustered together, form the Toronto building (far right).

Windows at the corners

Completed Structure

Steel column

ANDY CHRISTIE

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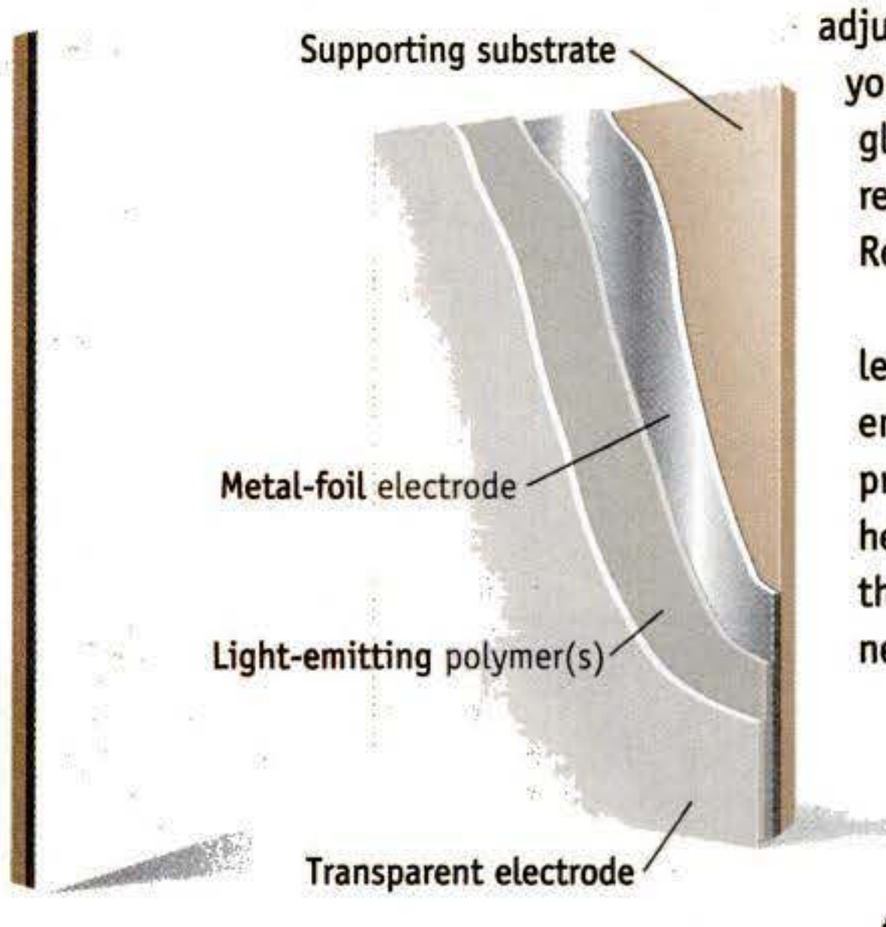
FUTURE TECH

A Colorful Switch for Walls

TIRED OF THE COLOR of your living room walls? In the future, you may be able to change it with the flip of a switch.

A number of research teams are developing plastic materials, called light-emitting polymers, that are flexible and thin enough to someday be used as "wallpaper." When these polymers are coated onto a thin layer of electrodes and voltage is applied to the electrodes, the polymers change color.

Light-emitting polymers were discovered in 1990 but were found to be unstable in the presence of oxygen. Since then, researchers at Ohio State University have worked with chemists at the University of Pennsylvania to develop a version in which some of the carbon atoms are replaced with nitrogen atoms, which do not react with oxygen.



Future electric "wallpaper" would change colors.

GREG MAXSON

A wall covering based on this research would have three layers: a metal-foil electrode pasted to the wall, a thin coating of light-emitting polymers, and a transparent electrode on the outer surface. Electricity passing between the two electrodes would make the polymers glow softly, like a TV screen. To change the color, you would simply adjust the voltage. "In the evening, you could introduce a little mood glow," suggests Arthur Epstein, director of the Center for Materials Research at Ohio State.

Epstein predicts it will take at least five years to develop a light-emitting polymer wall-covering product. Before that can happen, he says, researchers need to improve the longevity, durability, and brightness of the polymers.

Other products envisioned by Epstein's team include flexible signs for grocery stores and runways, molded displays for automotive instrument panels, and roll-up TV screens.—*Dawn Stover*

FIRE PREVENTION

Houses in the Mist

SOME HOMEOWNERS who want to install a fire sprinkler system can't, because their water supply can't provide enough water fast enough for the system to work properly. Soon, these homeowners may have another option: a mist system.

Many of the water droplets produced by a conventional sprinkler nozzle are larger than 1,000 microns. By comparison, a mist nozzle propels water through a much smaller orifice to create droplets typically 600 microns or less. This gives the same amount of water greater surface area, so it absorbs heat more readily and better suppresses a fire, some fire researchers believe. As a result, mist nozzles might use about one-third as much water as conventional nozzles. The National Institutes of Standards and Technology in Gaithersburg, Maryland, is testing prototype mist nozzles designed by Grinnell Corp. in Cranston, Rhode Island.

Mist systems do, however, have some drawbacks. The fog created could obscure the vision of people trying to escape a room. In addition, each mist nozzle can cover an area of only about 64 square feet; one residential sprinkler may cover nearly 400 square feet, so more sprinklers would be required per room. Moreover, mist systems need water under higher pressure, so a pump would be necessary. A mist system might cost $500 to $1,000 more than a sprinkler system, estimates Grinnell's Jerome Pepi.

Already, Grinnell sells mist nozzles for industrial and marine applications. However, mist systems currently are not available for private residences.—*J.A.G.*

TOOLS

Coming to a Retail Store Near You

SOONER OR LATER, the rechargeable nickel-cadmium battery in your cordless drill will wear out. Now there's a better option than tossing it: recycling.

You can drop off used batteries at designated stores. The Charge Up to Recycle program, organized by the Portable Rechargeable Battery Association, provides stores with collection boxes and pre-paid shipping labels. A recycling facility in Pennsylvania extracts the nickel for stainless-steel products. The cadmium is recovered for use in new batteries.

The program should be nationwide by 1997. Call 1-800-822-8837 for participating stores.—*J.A.G.*

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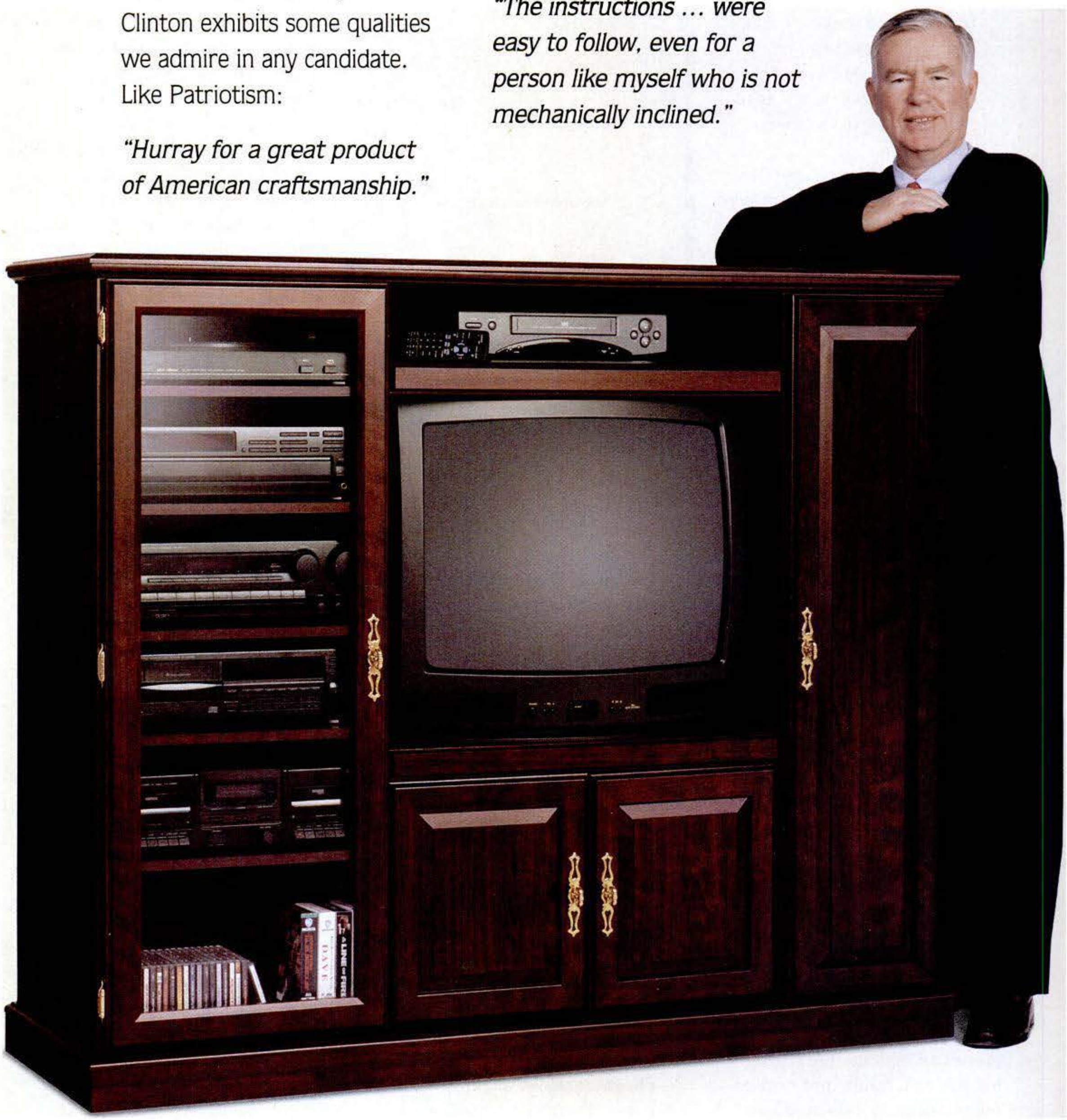

Bill Clinton, with his
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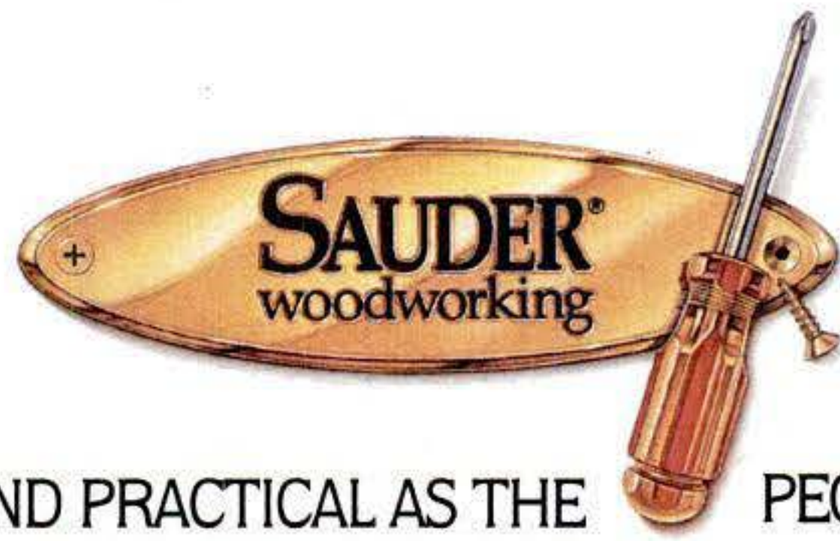

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More smart, practical, Sauder furniture. Shown here, part of the Heritage Hill Collection.

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COMPUTERS & SOFTWARE

EDITED BY CHRIS O'MALLEY

SLAM

MARVEL ONLINE

Spiderman brings his act to America Online—can the Web be far behind?

ENTERTAINMENT

Comical Computing

IN THE never-ending quest for appealing new "content," the multimedia world is turning to a very old format: the comic book.

America Online recently announced that it would bring Spiderman to cyberspace. Online readers will be able to leaf through a weekly eight-page story, clicking on certain images to reveal (and sometimes hear) hidden thoughts and clues. Other superheroes will join Spiderman in the not-too-distant future. Next up: Wolverine, of X-Men fame. AOL also has a Comics forum area.

A growing number of comic book characters - including those from the Doonesbury and Dilbert strips - are moving to CD-ROM discs too. Comics fans may also want to check out two other types of comic titles: The ComicBase Encyclopedia of Comics, from Human Computing (408-266-6883), and R.A. Montgomery's Comic Creator, from Hearst New Media (800-685-3322).—*C.O.*

MODEMS

Is 33.6 a Fix?

THE LATEST BLIP on the modem speed chart is 33.6, or 33,600 bits per second. That's up from the prevailing 28.8 standard, but will you be able to surf the Web more quickly?

Odds are, the answer is no—at least for a while. Many online services, such as America Online and CompuServe, and many Internet service providers do not yet support the new 33.6 standard, which is a variation of the 28.8 standard, known formally as V.34. But most new modems do support 33.6, and many existing 28.8 modems can be upgraded to 33.6 via software from their manufacturers (often available for free on their Web sites).

The real obstacle may be the limited capacity, or bandwidth, of the analog telephone line. Many experts peg the theoretical speed limit of regular phone lines at 35,000bps and most 28.8 modems can do no better than about 26,000bps in real-world conditions. A 33.6 modem may do a bit better with a similar modem at the other end, but the Web will probably still feel more like a leisurely stroll than a race.—*C.O.*

WEB WATCH

Our monthly filter of the Internet's World Wide Web.
(Addresses preceded by http://)

Ask an Expert
www.askanexpert.com/p/ask.html
Gurus, on agriculture to zookeeping

Explorations
www.tc.cornell.edu/er96/science96/Explorations
Physics from the subatomic to the cosmic.

Virtual Voice
www.virtual-voice.com
The lowdown on Internet phones.

Know Lead
www.knowlead.com
Lead-poisoning hazards in your home.

Deltaweb
www.deltaweb.com/reds
International air shows and flying squads.

Virtual Reality Lab
vrlab.uccb.ns.ca
Peek in on the nearly real.

Hot and Spicy Cooking Page
www.teleport.com/~cstarz
Marinades, sauces, and grilling tips.

Mathematical Resources on the Web
www.math.ufl.edu/math-web.html
Add'em, subtract'em, dial'em up.

WebPhoto
www.lnis.com/webphoto
Snapping tips and tricks from the pros.

ScubaDuba
www.scubaduba.com
Links to scuba gear and destinations.

Truckworld Online
www.truckworld.com
From monster trucks to SUVs.

Log Homes on the Internet
www.woodworking.com/loghomes
Ask, see, buy, build, and live.

Hurricane Resource Center
www.sprynet.com/sprynet/jedwar01/
Storm forecasts and tracking.

—*Suzanne Kantra Kirschner*

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DISPLAYS

A New Prescription for Computer-Weary Eyes

CALL IT THE PC grind. It's not a designer coffee for computer geeks, but rather a special eyeglass prescription for anyone who spends long hours at a PC screen.

A new FDA-approved device called the Computer Vision Tester, from Prio Corp., simulates a PC video display during an eye examination. This enables an eye-care professional to measure the eyes' reaction under real-world circumstances and to write a corrective prescription.

Eyes respond differently to video images than they do to printed characters, according to Prio. Printed characters have a consistent density and sharp edges, which enables the eyes to focus accurately. But video displays form letters with pixels, dots of light that are bright at the center and grow dim at their edges.

These so-called Gaussian images cause what optical physicians call a "lag of accommodation." Lacking the sharp contrast needed to lock in a focus, the eyes come to a "resting point of accommodation" beyond the plane of the video display, where the eyes focus when they have nothing to focus on. Eyestrain results as the muscles constantly attempt to return focus to the plane of the screen. With the Prio tester the examining professional can make a corrective prescription that brings the eyes' natural resting point back to the surface of the video screen.

These corrective specs are optimized for the 18- to 24-inch viewing distance between the eyes and the computer monitor. Consequently, they're not suitable for other applications, such as driving, which might require a separate prescription. But the computer vision glasses can be combined with contact lenses. About 400 U. S. facilities already have the Prio tester.—*Stephen A. Booth*

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DISK STORAGE

Going Gigabytes

Iomega's Jaz drive is sweet music to anyone in need of disk space.

REMEMBER WHEN two or three hundred megabytes in a hard disk drive seemed as vastly spacious as the cosmos? If it seems like a recent yet distant memory, that may be because programs, data files, and operating systems like Windows 95 keep getting bigger. And hard-disk capacities have been rising at an astronomical clip to keep pace.

When it comes to hard disks, megabytes are out. Gigabytes, or thousands of megabytes, are in. Quantum, Seagate, Western Digital, and others are all selling 1GB to 3GB drives for do-it-yourself upgrades—for about the same $200 to $350 as earlier drives.

Drives with removable cartridges are attractive alternatives, both for their unlimited storage capacity and portable media. And they're getting bigger, too. Iomega, best known for its 100MB Zip drive, recently began selling a drive called Jaz (about $600) that holds a gigabyte on every cartridge ($100 apiece). Syquest's EZFlyer 230 ($299) and Olympus' SYS.230 ($389), which each hold 230MB per cartridge ($30 and $10, respectively, apiece) are less costly routes to unlimited storage.

Terabytes are next, if you're counting.—*C.O.*

HANDS ON

Out for a Spin

ALL RIGHT, WAS that left onto I-85 for five miles and then take the first exit? Or was it eight more miles on I-58 and then right at the second exit? Confused? If so, you are probably a good candidate for Delorme's AAA Map'n'Go, a $39 CD-ROM trip planner for Windows PCs.

Map'n'Go takes directions to a new level.

Trip-planning programs have been around for a while, but two things set the Delorme product apart: It offers beautiful, highly detailed maps and has a couple of gee-whiz touches not available elsewhere, namely a Web link and the ability to interpret information from a Global Positioning Satellite receiver.

But first, the basics. Plotting a route is genuinely easy with Map'n'Go, and the millions of miles of roads it covers consistently translate into accurate directions. The disc also includes the familiar AAA ratings on thousands of places to stay and eat, as well as attractions and events.

All that works fine, but it's the external links that really impress. Its online connection lets you dial up the Delorme Web site directly from Map'n'Go and download current weather, event, and road construction data. In theory, at least, you need never encounter another Detour or Road Closed sign. Even more high-tech, you can actually track your progress as you drive—in the admittedly unlikely event you have a laptop computer with both a CD-ROM drive and a GPS receiver.

If you're looking for a specific address, the program dovetails with Delorme's Street Atlas USA program (also $39).—*Jon Pepper*

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AUTOMOTIVE

EDITED BY DAN McCOSH

SPORTS CARS

The "Civilized" Viper

THE DOOR RELEASE on the new Viper GTS Coupe is the first clue to how far this car has evolved from the RT/10 roadster: The latch, operated via a button on the door frame, is a technological marvel. A touch releases the unlocked latch from the outside—a marked improvement over the roadster's setup, which forces you to unbutton and reach through the Plexiglas side curtain to open the door when the roof is up.

Door locks aside, the GTS Coupe's take on the sports car theme is significantly different from the softtop's. Despite sharing with the roadster the 450-horsepower V10 engine and most of the chassis and suspension, the coupe body is stiffer and lighter. Another change: Chrysler has placed greater emphasis, it says, on deadening sound and alleviating drivetrain harshness—critical with a closed car.

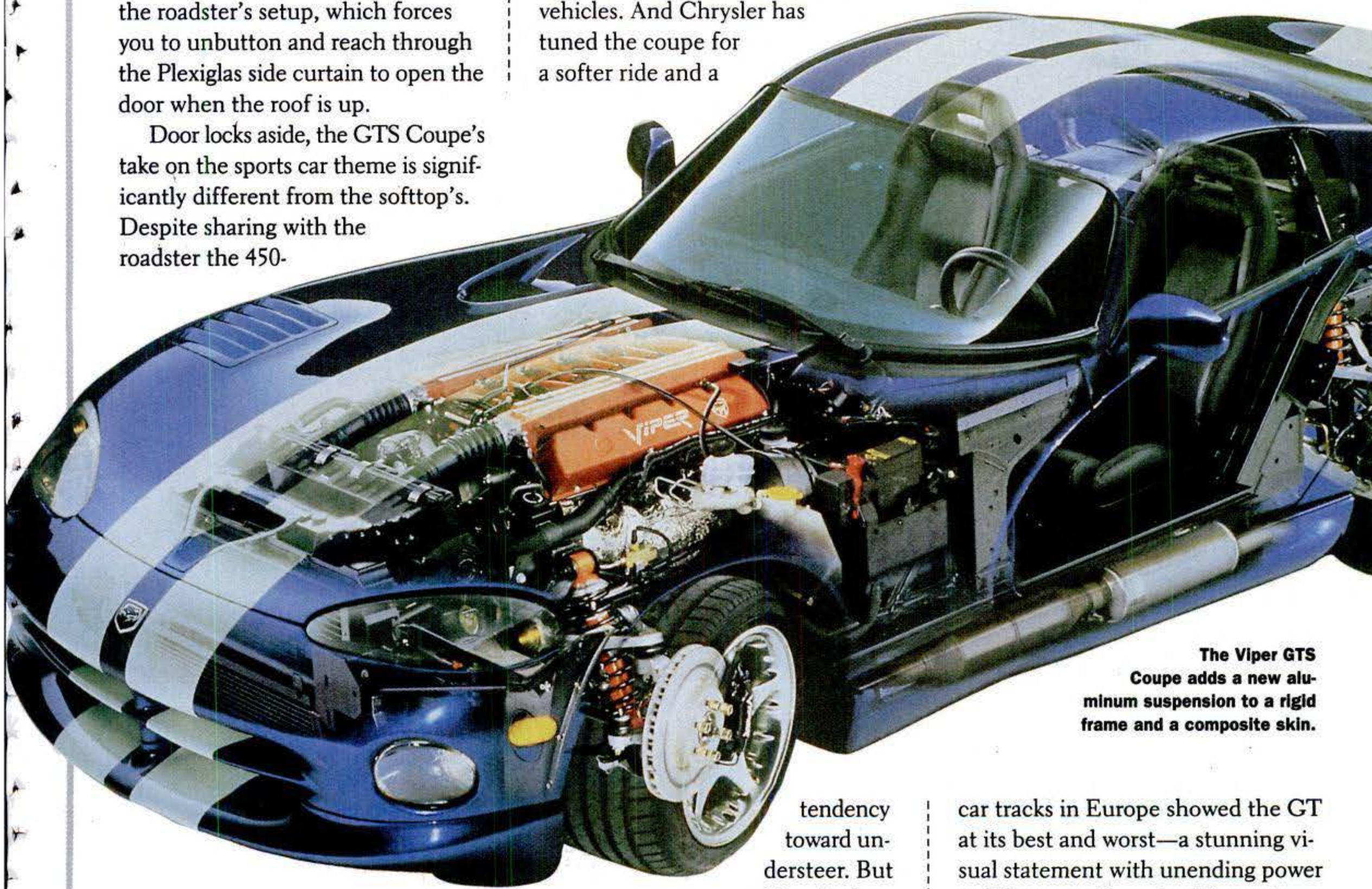
But it's still a raucous handful. The new engine is about 80 pounds lighter and now develops 450 hp, with 490 foot-pounds of torque. The latter comfortably accelerates the car with the tach still reading in three digits—highly unusual in an automotive universe now dominated by high-revving powerplants.

The aluminum suspension introduced last year on the roadster enhances steering precision on both vehicles. And Chrysler has tuned the coupe for a softer ride and a tendency toward understeer. But as with adjustments in sound deadening, more responsive steering is relative—our base of comparison is, after all, the rough-and-ready roadster. The torque of the monster motor can still bring the tail out, although end swapping is less likely.

Steering precision is compromised by a smallish steering wheel that's pitched at a slightly awkward angle. The pedals can be adjusted for leg stretch, however.

The Viper project was originally an exercise in making a fantasy show-car real. Along the way, it became a serious high-performance sports car. The coupe means business as well: Don't let strongly imitative styling that combines various historic cues to classic muscle cars—including an ersatz aluminum quick-fill gas cap that merely hides the real gas cap underneath—fool you.

A grand tour of historic sports car tracks in Europe showed the GT at its best and worst—a stunning visual statement with unending power and fearsome tire grip. The prototypes showed a high degree of variability, however, both in body fit and mechanical soundness—such as drivetrain noise, for example. Such a shortcoming would be tough to take in a production car with a price in excess of $70,000 .—*D.M.*



The Viper GTS Coupe adds a new aluminum suspension to a rigid frame and a composite skin.

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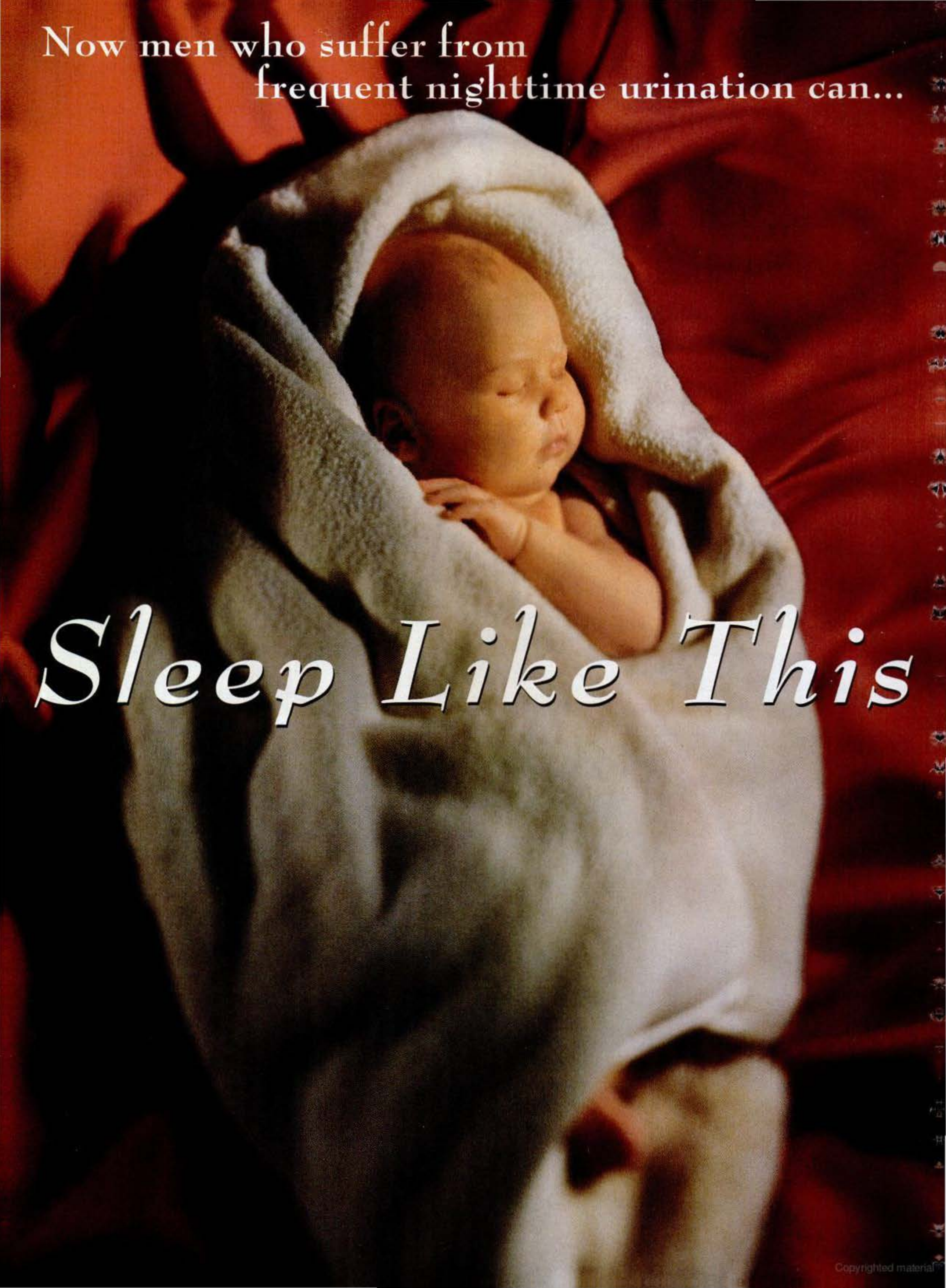

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Cardura may begin to improve urinary flow—day and night—in as little as 1 to 2 weeks.

Cardura is available only by prescription. So ask your physician if **Cardura** is right for you—if it is, your doctor can provide you with a trial pack to get you started.

Cardura can cause a sudden drop in blood pressure at the beginning of treatment or if you miss doses and then start taking the medication again. You may feel dizzy, faint, or light-headed, particularly after getting up from a chair or bed. Speak to your doctor about oral medications like Cardura and other treatment options for BPH such as regular monitoring of the condition or surgery.

Please see important information on the next page.

ONCE-A-DAY
CARDURA®
(doxazosin mesylate) Scored Tablets 1 mg, 2 mg, 4 mg, 8 mg

Cardura. Because BPH shouldn't be something to lose sleep over.

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ONCE-A-DAY
CARDURA®
(doxazosin mesylate) Scored Tablets 1 mg, 2 mg, 4 mg, 8 mg

PATIENT INFORMATION ABOUT CARDURA®
Generic Name:
doxazosin mesylate
FOR BENIGN PROSTATIC HYPERPLASIA (BPH)

Read this information:

- before you start taking CARDURA®
- each time you get a new prescription.

You and your doctor should discuss this treatment and your BPH symptoms before you start taking CARDURA® and at your regular checkups. This information does NOT take the place of discussions with your doctor.

CARDURA® is used to treat both benign prostatic hyperplasia (BPH) and high blood pressure (hypertension). This information describes CARDURA® as treatment for BPH (although you may be taking CARDURA® for both your BPH and high blood pressure).

What is BPH?

BPH is an enlargement of the prostate gland. This gland surrounds the tube that drains the urine from the bladder. The symptoms of BPH can be caused by a tensing of the enlarged muscle in the prostate gland which blocks the passage of urine. This can lead to such symptoms as:

- a weak or start-and-stop stream when urinating
- a feeling that the bladder is not completely emptied after urination
- a delay or difficulty in the beginning of urination
- a need to urinate often during the day and especially at night
- a feeling that you must urinate immediately.

Treatment Options for BPH

The four main treatment options for BPH are:

- If you are not bothered by your symptoms, you and your doctor may decide on a program of "watchful waiting." It is not an active treatment like taking medication or surgery but involves having regular checkups to see if your condition is getting worse or causing problems.
- Treatment with CARDURA® or other similar drugs. CARDURA® is the medication your doctor has prescribed for you. See "What CARDURA® Does," below.
- Treatment with the medication class of 5-alpha reductase inhibitors (e.g. Proscar®). It can cause the prostate to shrink. It may take 6 months or more for the full benefit of finasteride to be seen.
- Various surgical procedures. Your doctor can describe these procedures to you. The best procedure for you depends on your BPH symptoms and medical condition.

What CARDURA® Does

CARDURA® works on a specific type of muscle found in the prostate, causing it to relax. This in turn decreases the pressure within the prostate, thus improving the flow of urine and your symptoms.

- CARDURA® helps relieve the symptoms of BPH (weak stream, start-and-stop stream, a feeling that your bladder is not completely empty, delay in beginning of urination, need to urinate often during the day and especially at night, and feeling that you must urinate immediately). It does not change the size of the prostate. The prostate may continue to grow; however, a larger prostate is not necessarily related to more symptoms or to worse symptoms. CARDURA® can decrease your symptoms and improve urinary flow, without decreasing the size of the prostate.
- If CARDURA® is helping you, you should notice an effect within 1 to 2 weeks after you start your medication. CARDURA® has been studied in over 900 patients for up to 2 years and the drug has been shown to continue to work during long-term treatment.

  Even though you take CARDURA® and it may help you, CARDURA® may not prevent the need for surgery in the future.
- CARDURA® does not affect PSA levels. PSA is the abbreviation for Prostate Specific Antigen. Your doctor may have done a blood test called PSA. You may want to ask your doctor more about this if you have had a PSA test done.

Other Important Facts

- You should see an improvement of your symptoms within 1 to 2 weeks. In addition to your other regular checkups you will need to continue seeing your doctor regularly to check your progress regarding your BPH and to monitor your blood pressure.
- CARDURA® (doxazosin mesylate) is not a treatment for prostate cancer. Your doctor has prescribed CARDURA® for your BPH and not for prostate cancer; however, a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). A higher incidence of prostate cancer has been noted in men of African-American descent. These checks should continue even if you are taking CARDURA.®

How To Take CARDURA® and What You Should Know While Taking CARDURA® for BPH

CARDURA® Can Cause a Sudden Drop in Blood Pressure After the VERY FIRST DOSE. You may feel dizzy, faint or "light-headed," especially after you stand up from a lying or sitting position. This is more likely to occur after you've taken the first few doses or if you increase your dose, but can occur at any time while you are taking the drug. It can also occur if you stop taking the drug and then restart treatment. If you feel very dizzy, faint or "light-headed" you should contact your doctor. Your doctor will discuss with you how often you need to visit and how often your blood pressure should be checked.

Your blood pressure should be checked when you start taking CARDURA® even if you do not have high blood pressure (hypertension). Your doctor will discuss with you the details of how blood pressure is measured.

Blood Pressure Measurement: Whatever equipment is used, it is usual for your blood pressure to be measured in the following way: measure your blood pressure after lying quietly on your back for five minutes. Then, after standing for two minutes measure your blood pressure again. Your doctor will discuss with you what other times during the day your blood pressure should be taken, such as two to six hours after a dose, before bedtime or after waking up in the morning. Note that moderate to high-intensity exercise can, over a period of time, lower your average blood pressure.

You can take CARDURA® either in the morning or at bedtime and it will be equally effective. If you take CARDURA® at bedtime but need to get up from bed to go to the bathroom, get up slowly and cautiously until you are sure how the medication affects you. It is important to get up slowly from a chair or bed at any time until you learn how you react to CARDURA.® You should not drive or do any hazardous tasks until you are used to the effects of the medication. If you begin to feel dizzy, sit or lie down until you feel better.

- You will start with a 1 mg dose of CARDURA® once daily. Then the once daily dose will be increased as your body gets used to the effects of the medication. Follow your doctor's instructions about how to take CARDURA.® You must take it every day at the dose prescribed. Talk with your doctor if you don't take it for a few days for some reason; you may then need to restart the medication at a 1 mg dose, increase your dose gradually and again be cautious about possible dizziness. Do not share CARDURA® with anyone else; it was prescribed only for you.
- Other side effects you could have while taking CARDURA,® in addition to lowering of the blood pressure, include dizziness, fatigue (tiredness), swelling of the feet and shortness of breath. Most side effects are mild. However, you should discuss any unexpected effects you notice with your doctor.
- Keep CARDURA® and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT CARDURA® AND BPH TALK WITH YOUR DOCTOR, NURSE, PHARMACIST OR OTHER HEALTH CARE PROVIDER.

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ALTERNATIVE FUELS

Highest Tech Golf Cart

PALM DESERT, California, allows some 20,000 electric-powered golf carts to legally roam its streets, reflecting both the local interest in environmentally friendly cars and the city's large number of retirees. Soon this venue will become a testing ground for one of the more exotic and expensive alternative fuels.

A federally funded program at Humboldt State University plans to build five prototype golf carts powered by hydrogen fuel cells, as well as three full-size commuter cars. Both could be on the streets of Palm Desert by 1998. Researchers are hopeful that golf carts and utility vehicles will provide a specialty niche that ultimately paves the way for economical, general-purpose hydrogen-powered cars.

The program might almost be described as Byzantine for the twists it takes, especially in comparison to the two major alternatives: using electric power to charge the carts directly, or using the hydrogen produced by hydrolysis to fuel internal-combustion engines. These would be relatively clean ways to power the carts, although they would produce some nitrogen oxide byproducts. Fuel cells convert hydrogen to electricity by a chemical reaction that converts hydrogen and atmospheric oxygen to water. The source of the hydrogen is the chemical reversal of the process.

The cost of the fuel cells is estimated at about $45,000, although the research program includes work on reducing that figure.

Hydrogen for the carts will be produced by electrolyzing water, using electricity from nearby solar arrays and windmill-driven generators. The hydrogen gas will then be piped to two refueling stations in town—the first such stations in the U.S.—*Steve Nadis*

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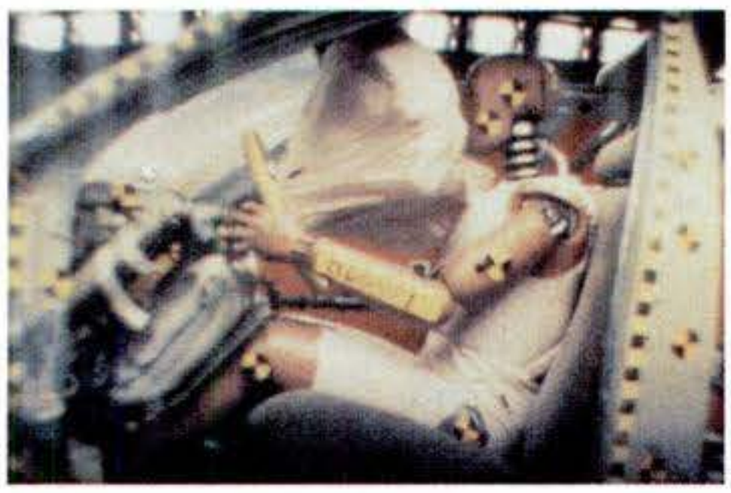
SAFETY

Airbag Crossroads

THE NEXT generation of airbags will be considerably more sophisticated, say a group of suppliers and government officials who gathered at the Michigan headquarters of Siemens Automotive, a major developer of airbag sensors and related hardware.

Change has already come to the first generation of airbags. Driver protection has been expanded, with passenger-side bags on most cars and, on one vehicle—the Kia Sportage—a kneebag for the lower legs.



Kia introduces the first knee airbag.

Multiple airbags enhance protection during crashes from the side—blamed for half of all traffic deaths.

But recently, a number of injuries and even fatalities have been reported involving passengers—particularly small children—who are too close to the explosion of a deploying bag. This is often caused by neglecting to wear a seat belt, which normally straps a passenger in a safe position.

Another problem stems from child seats propped against the airbag outlet. Mercedes has announced it is adopting the Siemens child-seat detector system, which uses a microchip imbedded in the base to detect improperly attached child seats.

Under development are "smarter" sensors that, after detecting a presence in the car, weigh the individual and measure the dimensions of the occupied position. These sensors detect the presence of a passenger, or of a child seat, and they know whether or not the seat belt is in use. Also under study is the use of short-range radar to detect a potential impact shortly before it actually happens—thus allowing a variety of deployment rates.

Such sensor concepts could make airbags more effective but add significantly to their cost.—*D.M.*

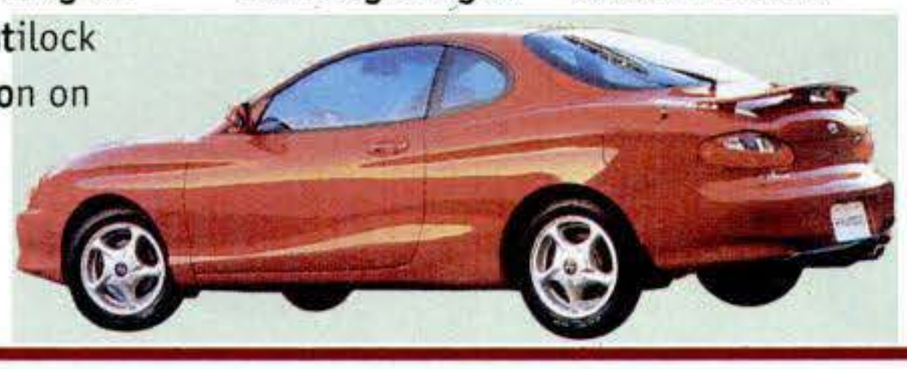
PREVIEW DRIVE

Sporty Hyundai

DESIGNERS AT Hyundai went for broke when they sculpted the Tiburon, a sporty coupe that's all curves and character lines.

The Tiburon comes in standard and plusher FX versions. The base car has a 1.8-liter, 130-horsepower engine, while the upscale model gets a 140-hp, 2.0-liter powerplant that creates a bit more torque at lower rpm. Both engines propel the Tiburon at a decent clip, and the car's handling on serpentine roads is deft. Antilock braking is an available option on the FX model.

Inside, well-placed controls and instruments and pleasingly sculptured surfaces make Tiburon's cockpit a nice place to be. Aided by slim roof pillars, visibility from the driver's seat also is quite good. Fit and finish and the choice of materials are laudable throughout, demonstrating that Hyundai is continuing to make great leaps forward from its faltering first offerings in the mid-1980s. Priced at $13,000 to $18,000, the Tiburon offers good value and personality without rough edges. —*Stuart F. Brown*



Hyundai updates its sport coupe with the new Tiburon.

ADVERTISEMENT

Technology To Go

FOURTH IN A SERIES

HIGH-TECH **INSULATION**

Keeping homes warm and cozy isn't an art, it's a science—and one that has become a "hot" subject with the introduction of many innovative high-tech, high-R (for Resistance to heat transfer) materials. As a result, today's home builders and remodelers can choose among widely different insulating methods adaptable to just about any home or situation. Here's a sample of what's available:

High-Density Fiberglass: By packing more fibers per square inch into typical between-the-studs batts, you can put more insulation into the same size wall cavity. This new standard was created as a way to meet ever-higher federal insulating guidelines at lower cost.

Cellulose Fiber: An old idea made new again, this recyclable, non-toxic, flame-retardant material comes from many sources including wood pulp, mill waste and newspapers. Mixed with a glue binder and blown into wall cavities, it effectively fills every nook and cranny.

Rigid Foam Board: Hardened polystyrene and polyisocyanurate foams are highly efficient thermal, vapor and liquid-moisture barriers. Available in convenient sheet form, they can be nailed in place, laminated with other materials like drywall or plywood, or used to insulate masonry walls and floors.

Reflective Foil Bubble Wrap: As crazy as it sounds, the same material used to protect packaging makes an excellent insulator when sandwiched between thin sheets of metal foil. Thousands of air pockets trapped in the plastic prevent heat transference, while the foil surfaces bounce radiant heat back at its source.

Mercury

IMAGINE YOURSELF IN A MERCURY

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ELECTRIC CARS

Of Tape and Batteries

ELECTRIC VEHICLES are a great idea. So what's the problem? It's the battery, which comes as no surprise: EV batteries haven't been able to store enough energy for anything near the range of a fully gassed-up car.

For the most part, the basic battery technology is not the culprit. The finger can be pointed at a tricky combination of performance, cost, reliability, and—apparently—the difficulty of achieving high-quantity production.

But change is in the air. For several years, researchers have been focusing on lithium. Lithium-ion batteries use the free ions in an electrolyte solution, producing a battery with about triple the capacity of lead-acid. This could yield a 200- to 300-mile range in an electric car.

Another lithium concept offers even more promise: the lithium-polymer sandwich, which uses a metallic lithium foil, a solid-film electrolyte, and another layer of film for a collector. The thin foil sandwich becomes a battery when miles of the film are spooled up. The solid electrolyte functions at about 100°C, which takes some energy storage but also guarantees operation in cold climates.

The battery's appeal lies in its high capacity, its ruggedness, and the fact that it can be made on machinery similar to that producing photographic film. Extremely thin film layers must be made accurately for it to work, however.

Now, 3M Corp. has joined forces with Hydro Quebec in the second stage of developing a practical lithium battery. Researchers at 3M say that a prototype could be delivered to auto manufacturers in three to five years. This stage attacks some seemingly mundane problems—engineering a battery case and packaging the battery, for example. The battery-making process comes naturally to 3M, one of the largest makers of photographic film in the world.

Will this be the long-awaited breakthrough battery? It's too soon to say with certainty, but the technology promises a long step forward within the next five years.—*D.M.*

PREVIEW DRIVE

Stealth Camry?

ATTENTION TO details has helped make Toyota's Camry one of the most popular midsize cars sold in America. The details continue to evolve through a redesign for 1997—only with greater subtlety. The Camry is now a slightly larger (105.2-inch wheelbase), slightly more refined car that retains its appliance-like solidity. The net effect is a vehicle that is extremely pleasant to drive but doesn't exactly turn heads.

Just when U.S. automakers are rediscovering that a focus on eye-catching styling has its risks, and even some Asian designers are turning toward sharp edges, the new Camry remains more mainstream; the addition of a raised rain gutter (replacing flush glass for the windshield), meant to redirect airflow and eliminate noise a trifle, seems an aerodynamic quirk. Improvements come mainly in refinements and ergonomic details, such as relocating the lumbar support handle. The interior has been updated, with slightly more rounded surfaces, but it remains straightforward, with roomy seating.

A rainy back-road sojourn revealed the merits of a traction-control system that's new this year. Antilock brakes are standard on most models. Power is improved, both for the base 2.2-liter, four-cylinder engine, now 133 hp, and the 3.0-liter, 194-hp V6. The latter is so quiet that, more likely than not, you'll sooner or later experience the "crunch" that comes from trying to start an already running engine.

Camry has earned loyalty, not for its style, but for its almost deliberate lack of one. The reason its proponents are so devoted: When it comes to quality, the car delivers. The finish of the new exterior alone, for example, almost passes for that of a small luxury model. And as its overall smoothness and near soundlessness take over, the Camry's mechanical integrity sweetens the pot. Speculation has arisen in the industry that Toyota will actually cut the Camry's price in 1997, but the carmaker denies it.—*D.M.*

Camry's new exterior blends subdued styling and meticulous attention to fit and finish.

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SCIENCE & TECHNOLOGY

EDITED BY DAWN STOVER

EARTH

Spin Master

WANT TO SEE the world's largest electric motor? You'll have to travel to the center of the Earth.

Seismologists Xiaodong Song and Paul G. Richards at Columbia University's Lamont-Doherty Earth Observatory have discovered that Earth's solid iron core behaves like a gigantic electric motor. Electric currents within the core interact with the planet's magnetic field, causing the innermost portion of the core to rotate like a motor.

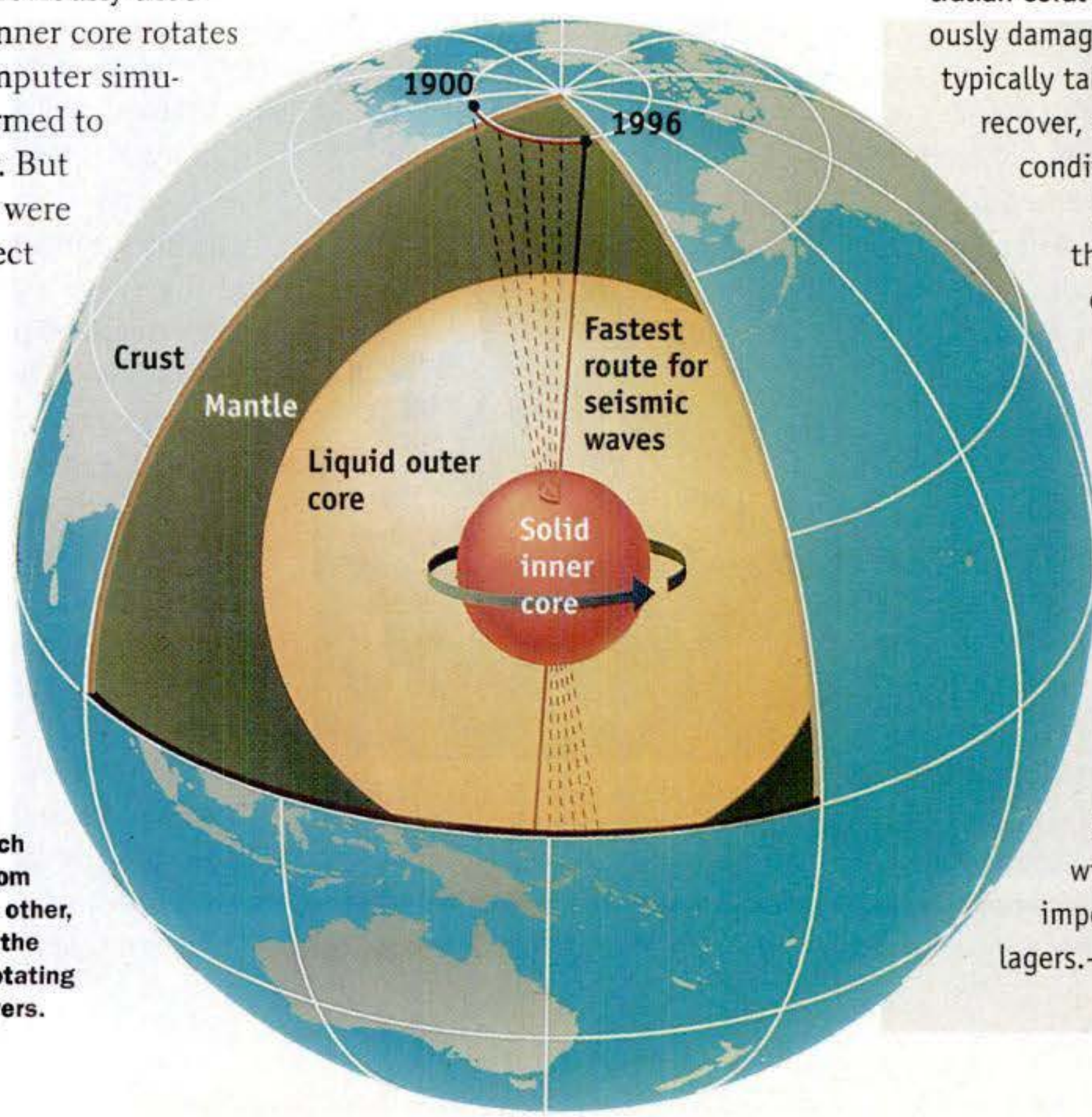
The inner core spins faster than the rest of the planet by about two-thirds of a second each day, or a full revolution every 400 years. That is astonishingly fast compared with other geologic movements—it's 100,000 times faster than continental drift, for instance.

Scientists had previously theorized that Earth's inner core rotates independently; computer simulations were performed to support this theory. But Song and Richards were the first to find direct evidence of the core's movements.

Because of the tremendous heat (about 7,000°F) and pressure at Earth's center, the iron atoms there have formed a crystalline structure analogous to the grain in wood. As a result, seismic waves passing through the core travel at different speeds when moving in different directions. "Along one line, sound waves travel faster than along any other line," says Richards. This line was used as a marker to measure the core's movements.

Richards and Song analyzed seismic waves received in Alaska from 38 earthquakes that occurred between 1967 and 1995 in the vicinity of the South Sandwich Islands, near the South Pole. They found that the waves traveled 0.3 seconds faster in the 1990s than they did in the 1960s, proof that the "marker" in the Earth's core had moved.

For scientists, the discovery has profound implications. "It will help resolve how Earth's magnetic field has been generated and maintained for 3.5 billion years," says Song.
—*Mariette DiChristina*



A "marker" line, the fastest route along which seismic waves travel from one end of Earth to the other, showed scientists that the planet's inner core is rotating faster than its outer layers.

THE OCEANS

Killer Catches

THE SAME TYPE of poison that carries out the death sentence in some American prisons is killing fish and corals in the South Pacific.

Fishermen have been dumping deadly sodium cyanide into once-pristine waters to stun large fish, so they can be easily captured for the restaurant and aquarium trades. Devastation follows. The toxin often kills small fish and corals, transforming shallow reef communities into aquatic graveyards.

While the waters around Indonesia and the Philippines have been hit hardest, New Guinea appears to be the next major target. Large vessels, carrying as much as 20 tons of live fish, supply thriving markets in Hong Kong, China, and Singapore, where gourmands perpetuate the deadly harvest by paying top dollar for prized species.

"Hundreds of reefs have been affected, and there's no end in sight," says Robert E. Johannes, an Australian coral-reef ecologist. "Seriously damaged reef communities typically take several decades to recover, even under favorable conditions."

But it is unlikely that these violated reefs will ever again be allowed to flourish. Poor villagers in the region traditionally have counted on reef fish to feed their families and earn a little spending money. Experts predict that most of the fish and invertebrates that drift back to cyanided reefs will be snatched up by impoverished coastal villagers.—*Donald J. Frederick*

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ANIMALS

Bees of the Sea

ANTS, TERMITES, and bees aren't the only animals that live together in colonies dominated by a lone "queen." A species of snapping shrimp found inside sponges on Caribbean coral reefs has also

J. EMMETT DUFFY

Snapping shrimp defend their "queen."

adopted this "eusocial" lifestyle, according to J. Emmett Duffy, a marine scientist at The College of William and Mary. The *Synalpheus regalis* shrimp he studied are the first eusocial animals ever seen in a marine environment.

Colonies of the shrimp may have 300 or more individuals, but only one reproductive female. The other shrimp, which are smaller than the queen but have larger chelae, or fighting claws, defend the colony's sponge against intruders.

Like termites and other cavity nesters, the *Synalpheus regalis* shrimp cooperate mainly for the purpose of protecting their home, Duffy believes. Food particles are plentiful in the internal canals of the sponges where the shrimp live, but finding an unoccupied sponge in the coral rubble is even more difficult than finding an affordable apartment in Manhattan.—*D.S.*

MEDICINE

Death Sentence

IN A STUDY THAT other Alzheimer experts have called "pivotal," researchers at the University of Kentucky have found that a person's writing style can predict, with surprising accuracy, that person's likelihood of eventually getting Alzheimer's disease.

The research team studied short memoirs that 93 nuns, all born before 1917, had written when they took their vows in their early twenties. The researchers found that the nuns who had written more grammatically complex, idea-rich sentences proved far less likely to get Alzheimer's in old age than those who wrote simple sentences. The results were so consistent that an analysis of a given nun's writing style could predict with 90 percent accuracy whether she would later get Alzheimer's.

Most experts agree that the findings, which suggest Alzheimer's effects begin early in life, could be a major stride toward understanding the disease. It affects roughly one in four Americans and costs society an estimated $100 billion a year.—*David Dobbs*

THE SOLAR SYSTEM

Magnetic Moon

IN JUNE, NASA'S *Galileo* spacecraft got its first close-up look at two of Jupiter's largest moons, Ganymede and Io. It saw surprising signs of geologic and magnetic activity that are usually associated with planets, not moons.

Photographs and data sent back by *Galileo* show that the icy surface of Ganymede, the largest moon in the solar system, is crisscrossed by deep furrows and faults. The surface markings are indicators of geologic processes at work, possibly driven by a molten metal core not unlike that of Earth.

If Ganymede does have a metallic core, that could also explain why the moon appears to generate its own magnetic field. Instruments detected the field as Galileo flew within about 500 miles of Ganymede. The same instruments detected a "hole" in Jupiter's magnetic field as *Galileo* passed near Io, raising the possibility that it too may have a magnetic field, although more recent data contradict this theory. No other moons are known to generate their own magnetic fields.

Flying within 559 miles of Jupiter's moon Io, *Galileo* has detected a huge iron core.

Scientists learned from the recent flybys that Io has a giant metallic core, probably composed of iron and iron sulfide. The scientists inferred the presence of metal by measuring slight deviations in *Galileo's* trajectory as the spacecraft passed the moon. Io orbits close to Jupiter, so it is tugged and distorted by the giant planet's massive gravity field. That, perhaps, accounts for the geologic activity on Io. *Galileo's* recent photos of Io show dramatic changes since *Voyager* flew by the moon in 1979.

Launched in 1989, *Galileo* has been orbiting Jupiter since last December. The spacecraft's close encounters with Jupiter's moons, including Callisto and Europa, will continue through 1997.—*D.S.*

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CHEMISTRY

Detecting a Single Molecule at a Time

IOWA STATE University professor Ed Yeung has achieved the Holy Grail of analytical chemistry: He has developed a way to detect and count individual molecules. So far, Yeung's method has been perfected for only one type of molecule, but the potential is larger. Soon chemists may be able to detect a single pesticide molecule on an apple, for instance, or one HIV virus in a blood sample.

Yeung's method uses an enzyme that quickly catalyzes a chemical reaction. The reaction's product fluoresces under ultraviolet light. Yeung puts a small sample of the enzyme mixture into a capillary tube—a long, microscopically thin glass cylinder—and uses a magnifying glass to painstakingly count the fluorescent "hot spots" resulting from the activity of individual molecules.

The method can be extended to other chemicals by linking the enzyme to an antibody that is specifically keyed to the chemical that scientists want to track. Because antibodies bind one-on-one with their targets, this approach has been compared to fishing with a hook baited for a very specific type of fish. The fish is the target molecule, the hook is the antibody, and the enzyme attached to the antibody is a tracking device that goes along for the ride.

When all of the target molecules in a sample have been hooked, enzymes attached to antibodies that have caught their "fish" can be separated from those that haven't. The hooked "fish" can then be inserted into the capillary tube and counted. Chemists are already inventing new terms such as the yactogram (10^{-24} gram—that is a one with a decimal point and 23 zeros in front of it) for the tiny amounts of material that will soon be detectable by Yeung's technique.—*Richard A. Lovett*

We hope you'll come visit Tennessee this year. And if you do, we hope you'll include a stop in Lynchburg.

ONE OF THE FEW THINGS older than Jack Daniel's in the state of Tennessee is the state of Tennessee.

At Jack Daniel Distillery, we're proud to celebrate Tennessee's Bicentennial this year. For it wasn't long after being granted statehood that Tennessee became known as the home of Mr. Jack Daniel and his charcoal-mellowed whiskey. (We still use his method today.) Our great state has seen many changes in the past 200 years. But if you're a whiskey drinker, we think you'll be glad Jack Daniel's isn't one of them.

SMOOTH SIPPIN' TENNESSEE WHISKEY

Tennessee Whiskey • 40-43% alcohol by volume (80-86 proof) • Distilled and Bottled by Jack Daniel Distillery, Lem Motlow, Proprietor, Route 1, Lynchburg (Pop 361), Tennessee 37352
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You Need The Edge. We Deliver.

Invisible waves shield you in a sonic mosquito net.

Tiny belt-clip Mosquito Expeller broadcasts in super high-frequencies flying bloodsuckers *detest.* Camping, hunting, fishing, or working outside – everyone will wonder why you're the only one not slapping and scratching. Even put one on your night table for an undisturbed sleep. Battery included.

■ **Electronic Mosquito Expeller #06-MS $14.95**

Start now and look dynamite in just 30 days!

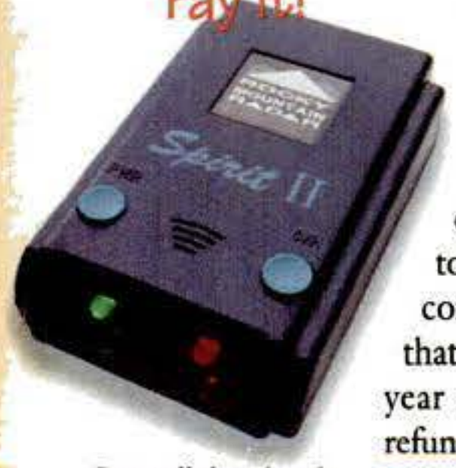
Instead of killer sit-ups and time-devouring workouts, take the Abflex challenge: just 3 minutes a day, 5 days a week. You'll look and feel great, or your money back.

It's the first home exercise machine to tone all four abdominal muscle groups. Why shell out hundreds for a big clumsy exercise machine? For a fraction of the cost, Abflex tones you in half the time. And best of all, you can take it anywhere. *Order now and receive the training book and video absolutely free.*

■ **Abflex Fitness Machine #600-FX $55.00**

Powerful new jamming gear shifts your car into the undetectable zone.

You Get A Ticket & We Pay It!



With the Spirit II, you are invisible to radar. And it's completely legal nearly everywhere. Spirit is a "passive" jammer – not a transmitter. It mixes a radar signal with a modulating FM chirp, streaking it back, and confusing the radar gun. The 2 to 3 mile range gives you time to correct your speed. So effective that if you get a ticket in the first year of use, the manufacturer will refund your fine!

Jams all three bands: X, K, and KA, too.

■ **Spirit II Radar Jammer, with micro-circuitry #SPR-2 $119.95**

Check with your local and state authorities before ordering. Not available to Washington D.C., or OK residents. Use with your radar detector for complete protection.

Introducing the sunglasses stolen from mother nature.

Each lens captures the full spectrum of light, so you see clearly, with less distortion. Then glare and haze are neutralized, polarized, and reflected back. With zero UVA, UVB, and UVC. Your eyes relax, yet you see the complete rainbow of color. Eagle Eyes are the most soothing eye protection you'll ever own – guaranteed.

■ **Eagle Eyes Full Spectrum Sunglasses #8527 $39.95.**

Complete with metal case and lifetime guarantee. If they ever break, the maker will replace them absolutely free.

Micro-size voice disguiser even works with pay phones!

Fool your friends, confuse your enemies, or be your own secretary.

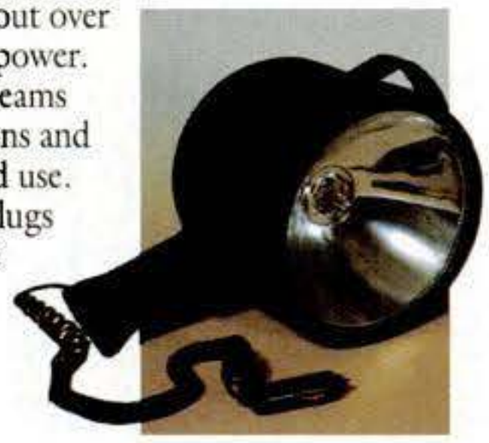
Unlike other voice-disguisers, the Micro-Disguiser has no modular hook-ups! Slip it from your pocket and place it over any phone's mouth-piece! Miniature electronics alter your voice over a sliding range of three levels.

■ **Pocket Micro Voice-Disguiser #VC-168 $39.95**

Get one for a woman friend, too, and let harrassing callers think a man is at home.

New handheld light bazooka blasts shadows over a mile away!

The Light Cannon puts out over one and half million candlepower. Used by police and search teams worldwide. Unbreakable lens and housing are built for rugged use. Completely rechargeable, plugs into dash, home AC, or use totally cordless!



■ **Cordless 1.5 Million C.P. Light Cannon #CL715 $59.95.**

Zap away pain. Without drugs or needles!

Touch it to a tired or sore spot. Then push the red button. Inside, two crystals collide, sending a stimulus blocking signal. You feel a harmless tingle, and the treatment is complete!

Similar results have been reported when Crystaldyne is applied to pressure points. Sports professionals have found it can relieve sudden pain, muscle spasms, and more.

There is no device like it. Requires no batteries or refills.

■ **Crystaldyne Pain Reliever #CZ-2000 $49.95**

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The sound amplifier you may have read about. Whisper 2000 captures even far-away sounds, and delivers them to you, crisply and clearly. Great for nature study, security, lectures. Built-in volume lets you adjust for sensitivity. Complete with ear-phones and our no-risk guarantee.

■ **Whisper 2000 Sound Booster #W-2000 $18.95**

Own the last of Russia's restricted issue spy glasses.

Designed for Soviet operatives. All metal micro-binoculars fold away to disappear into palm or shirt pocket. Yet super advanced coatings, and big 2.5 x 17.5 power yields crystal clarity, even in low-light conditions. Hunting, sports events, concerts, nature study, or surveillance.

■ **Dual Focus KGB Micro-Binoculars #R-215 $29.95**

Can also be used reversed as low power microscope. Includes Russian documentation. Hurry, comrade, supplies limited.

Back off highway bullies!

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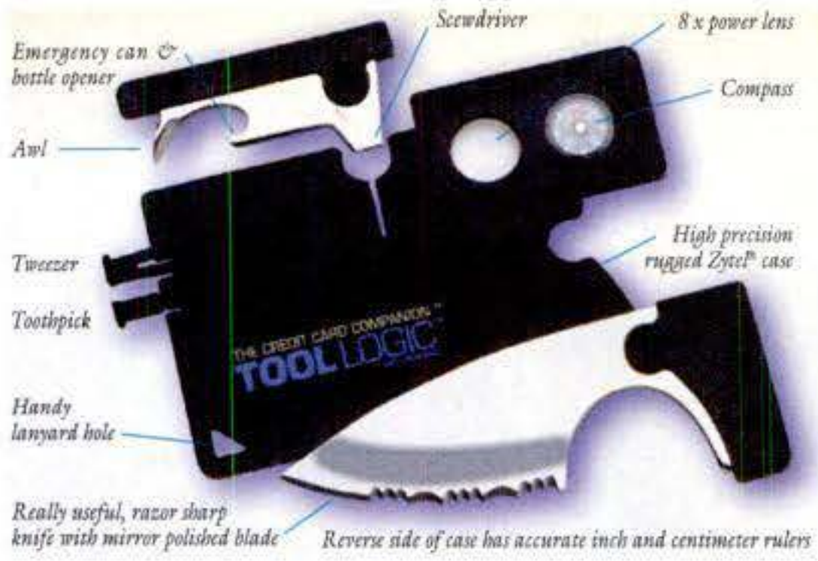

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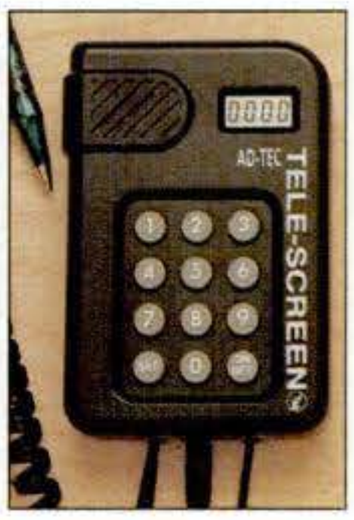
■ **The Moonwalker Night Vision Scope #NZT-12 ~~$399.00.~~ Your price $249.00!**

Now Waterproof!

Take back control of your telephone.



Tele-Screen™ Phone Protector eliminates unwanted calls. Harassing calls, sales calls, any call you wish. Incoming calls are greeted by a voice prompt: *"Thank you for calling. Please enter the four-digit pass-code."* Your phone rings only if the caller enters the correct code. Voice prompt repeats and if no code is entered, the caller is automatically disconnected! Use the keypad to change the code, or de-activate the unit. Also secures fax and modem lines!

■ **Tele-Screen™ #TS-300 $44.95**

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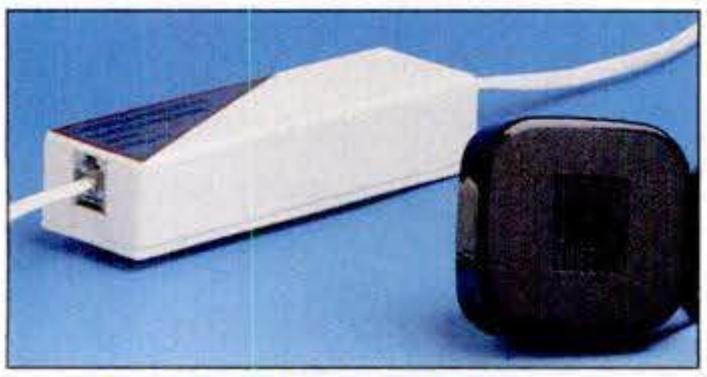

Re-capture your stolen privacy. New Caller I.D. Blocker lets you call with confidence and security.

Did you know that every time you make a call, you are giving out your name and phone number? The new Automatic Caller I.D. Blocker gives you back your privacy. Simply click it into your phone jack, and all phones on the line are secured. Let caller I.D.'s draw a blank – especially important for transacting business, or for women or children home alone. Best of all, it's completely automatic. No need to dial special codes or services. Once installed, it does the rest.

■ **The Automatic Caller-I.D. Blocker #PVCY-100 $39.95**

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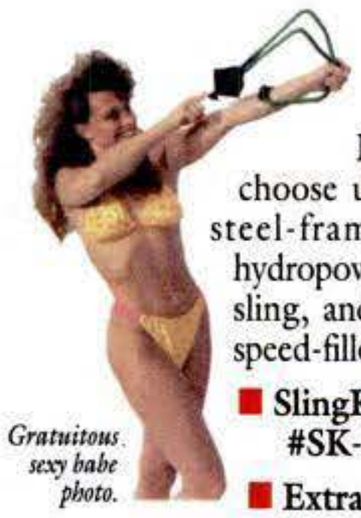

Gratuitous sexy babe photo.

Handheld catapult launches water grenades 200 feet away!

Become a beach or pool warrior this year! Or choose up sides in an open field. New galvanized steel-frame SlingKing gives new meaning to hydropower. Pull back on the wrist-braced neoprene sling, and let it rip! Comes with 100 balloons and speed-filler bottle – prepare a new barrage in seconds.

■ **SlingKing Water-Balloon Wrist Rocket #SK-2000 $26.95**

■ **Extra Water-Balloons, 100 pack #BLN-100 $2.95**

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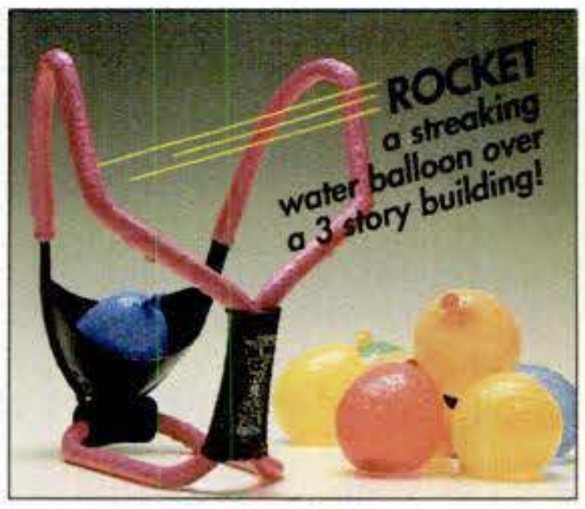

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ELECTRONICS

EDITED BY FRANK VIZARD

MUSIC

New Guitar Licks

FOR THE BETTER part of the century, the guitar has enjoyed unrivaled popularity. Part of the reason for its success has been the constant evolution of the instrument's sound. Hoping to continue that dominance into the next century is the goal of the new Roland VG-8 V-Guitar system.

At the core of this new system is a technology called Composite Object Sound Modeling, which allows the guitarist to produce an almost unlimited palette of sounds. While guitar synthesizers have been available for a number of years, they have limited ability to express a guitarist's "touch." The way a player bends a note, slides on a string, or uses vibrato is severely compromised. By contrast, the VG-8 can communicate the entire range of musical nuance available to the guitarist.

The VG-8, which lists for $2,695, functions in two modes that can be used individually or in combination. In the Variable Guitar Modeling mode, you can select the type of guitar body, pickups, amplifier, speaker, and microphone that you want to emulate. There are also presets for the trademark guitar sounds of Jimi Hendrix, Eric Clapton, and others.

In the Harmonic Restructure Mode, you can create completely new sounds by controlling the many harmonics in the vibration of the string. This also allows you to control the pitch of each individual string so you can play in different tunings without having to retune the guitar. —*Perry Beekman*

Who can play like Clapton? Hit a button and you can.

K. DANIEL CLARK

DISPLAYS

Taking Flat to New Heights

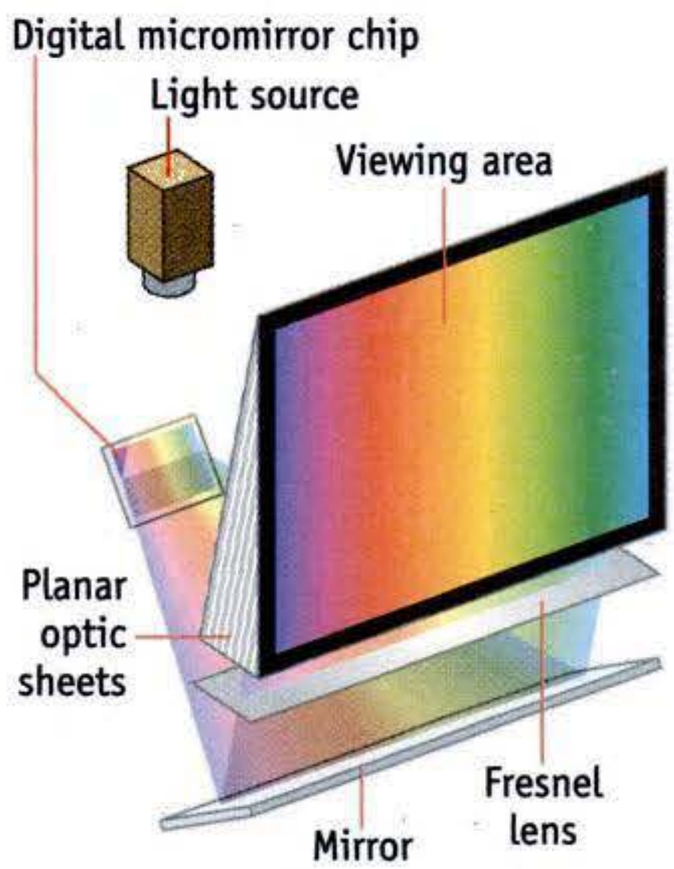
REALLY BIG TV SETS for home theater generally have some big drawbacks—namely, the bigger the display, the wider and heavier the box; brightness also suffers.

Now imagine a lightweight plastic display that can be as big as you need it—six feet would be no problem. With its black background, the display looks clear and bright even outdoors at midday. Unlike liquid crystals, it won't malfunction in cold weather. Because the light comes directly from the screen (and not through glass), you can see the picture clearly, even almost edge-on. OK, stop imagining: The basic technology exists today in prototype form.

James Veligdan, of the Brookhaven National Laboratory in Upton, New York, calls his new viewing device a planar optic flat-panel display. Besides TV, potential uses for the idea, which is patented by Associated Universities, include video-advertising displays, computers, car dashboard and aircraft-cockpit displays, as well as portable maps that could be used by the military.

How does it work? "It's simple," says Veligdan. "Unlike CCDs [charge-coupled devices] or plasma, this is going to be a plastic extrusion." Sheets of clear acrylic are bonded together and cut at an angle with a diamond-tipped bandsaw. Between each sheet is a material with a lower refractive index. Light from a laser or conventional projection system travels through each "wave guide" sheet, which ends at the screen. Each layer becomes one line of resolution [see illustration]. When extruded, a 200-layer display would be 1/16 inch thick; 2,000 layers, around two inches thick.

The display will be interactive, says Veligdan. "A viewer can control the TV remotely by using a laser pointer, just like a person would use a mouse to control a computer," he says. "You can't do that with any other type of display screen." Silicon-diode arrays could "read" the location of the incoming light.—*Mariette DiChristina*



A new display beams light through sheets of acrylic (shown thicker than actual) to create a lighter, brighter alternative.

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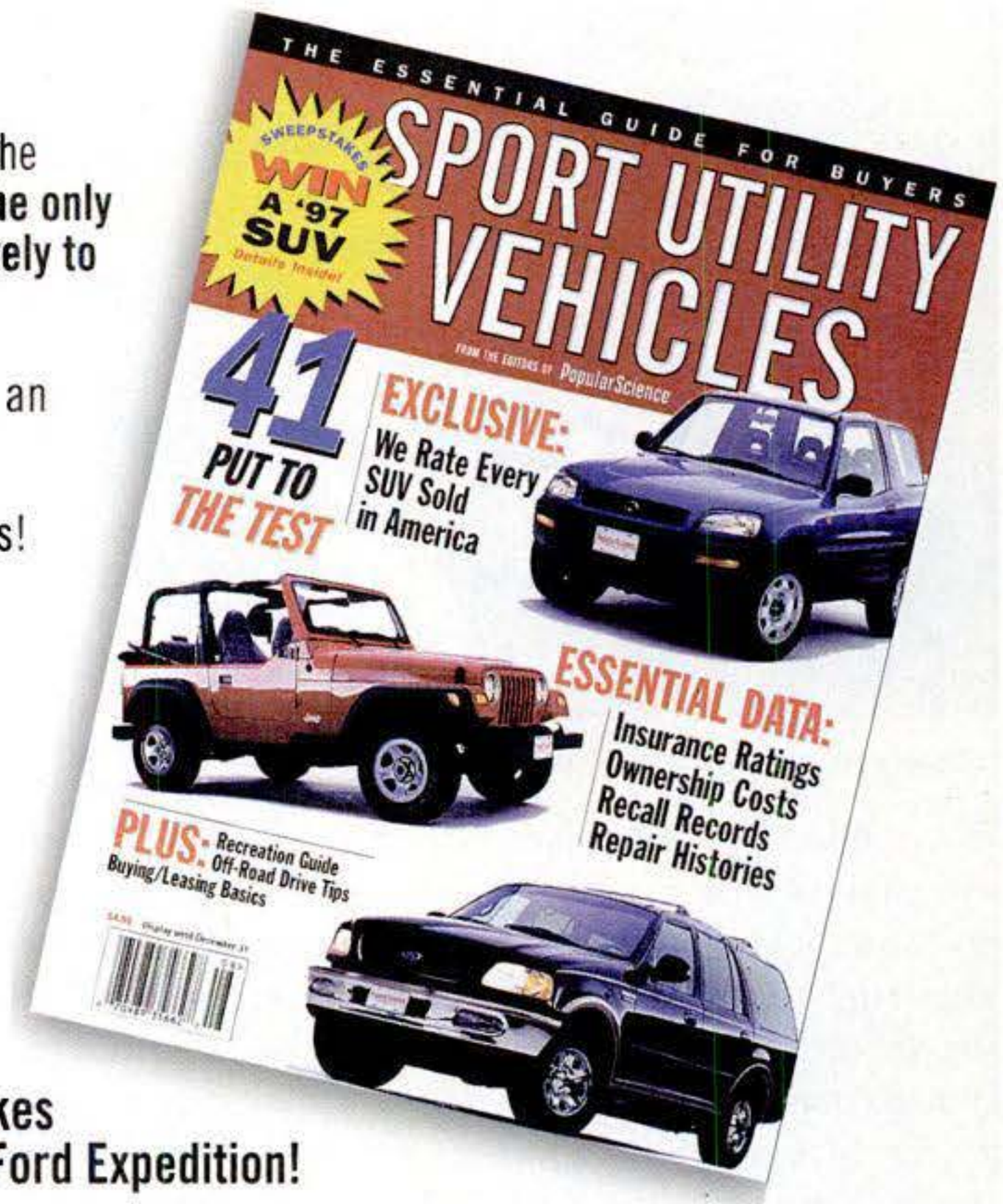

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TELECOMMUNICATIONS

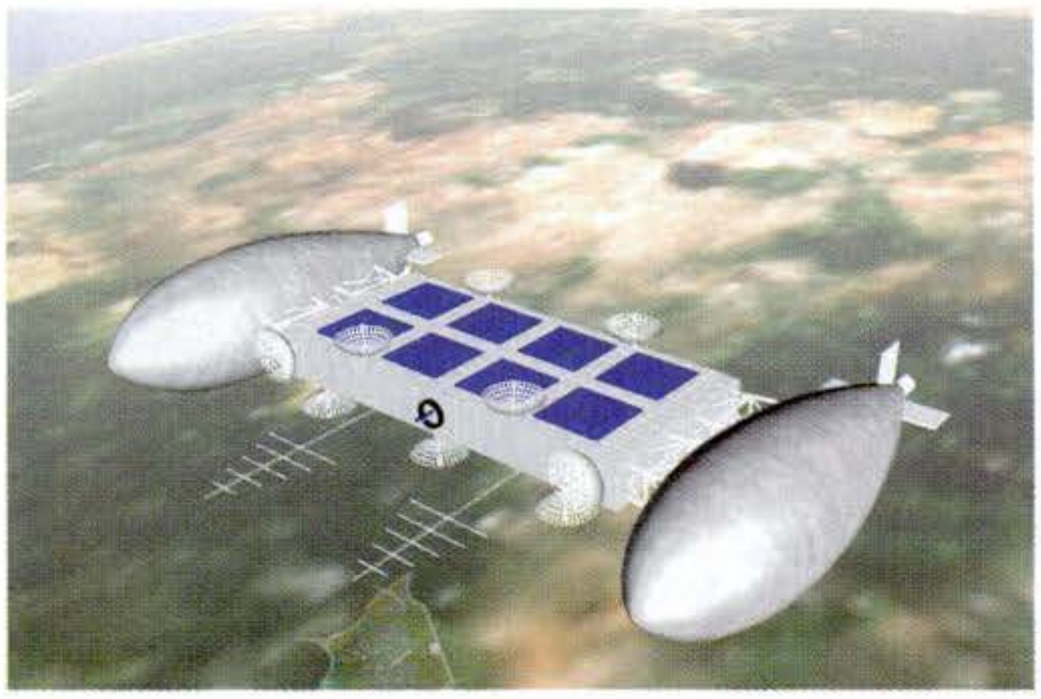
Messages by Balloon

PROVIDING GLOBAL Internet access with satellite networks in low-earth orbit has been a hot idea for several years. Now a Virginia start-up company proposes to do the same thing for less money by sending balloons into the stratosphere.

Until recently, this idea was impractical. Communications platforms need to stay in one place to receive and transmit messages. Unfortunately, stratospheric air is thick enough to have destabilizing winds, yet too thin to support conventional combustion or jet engines. Sky Station International of Chantilly, Virginia, thinks it has solved this problem with the development of the Corona Ion Engine.

The ion machine uses ambient air as fuel. Developed by UCLA physics professor Albert Wong, the engine takes a large group of negatively charged ions from the air and combines them with another large group of negative particles. The two ion groups naturally repel each other, creating a force that works as a propellant. About the size of a car engine, an ion engine could last as long as a decade.

Sky Station's plan calls for ion engines to keep 250 platforms in fixed positions 100,000 feet above the earth. Hanging between two Hindenburg-like dirigibles, each 40-ton platform would support football-field-size solar panels and antennas for the transmission of signals to and from individual handheld communicators.



Sky Stations would communicate through laser and microwave beams.

Sky Station is claiming that the platforms' proximity to the ground will allow it to provide data speeds that are faster than those proposed by planned orbital satellite systems. And floating balloons costs a lot less than space launches—$4.2 billion versus $9.4 billion for the proposed Teledesic satellite system. Sky Station says it will offer service at a cost of 10 cents per minute.

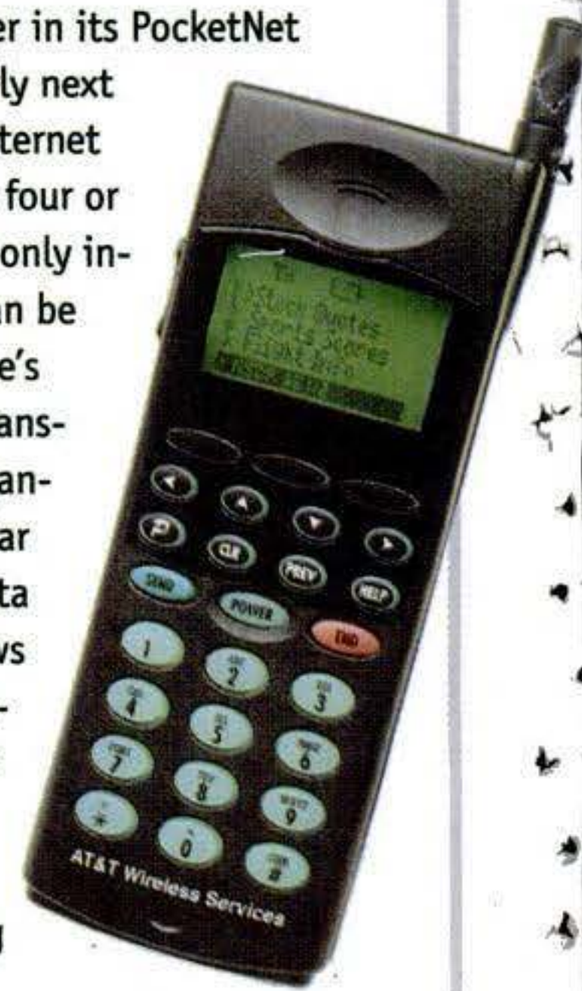
The low price has generated interest from organizations like CARE and the World Bank, which hope the system will be affordable for underdeveloped nations. If all goes well, a test platform could rise into the clouds by 1998.—*Heather Millar*

MOBILE PHONES

Internet on the Go

DIALING UP the Internet takes on a new meaning with the unveiling of mobile phones capable of displaying Internet data.

AT&T will usher in its PocketNet mobile phone early next year. A special Internet browser retrieves four or five lines of text-only information that can be read on the phone's display. Text is transmitted using a standard called Cellular Digital Packet Data (CDPD) that allows for data transmission over cellular phone networks. Short messages can be sent using the phone's keypad. With a nickel-metal-hydride battery, the PocketNet weighs in at 11.6 pounds.



Call the Web.

In Europe, Nokia is selling its 9000 Communicator with Internet access for around $2,000. The 14-pound Nokia mobile phone splits open to reveal a keypad and display screen for data communication. The Nokia 9000 operates on a digital mobile-phone network being used in Europe; the 9000 will not be introduced in the United States until similar digital networks are more widely available.—*F.V.*

VIDEO

No DVD for Now

THIS WAS TARGETED TO BE the year of the digital versatile disc (DVD). The new format for home video and computers is designed to deliver unheard-of picture quality and storage capacity. Well, kids, you can scratch DVD off your Christmas list. In all likelihood, the format won't make it onto store shelves until next year. The big holdup? The people who'll be supplying the software—namely the movie industry—want some type of data encryption to prevent unauthorized copying.

While concern over intellectual property rights is well-founded, the movie industry, after all, cried foul when the VCR was introduced. Today, videocassette sales and rentals are a huge source of Hollywood's profits. Chances are good that history will repeat itself, especially if DVD movies are priced in the $20 range.—*F.V.*

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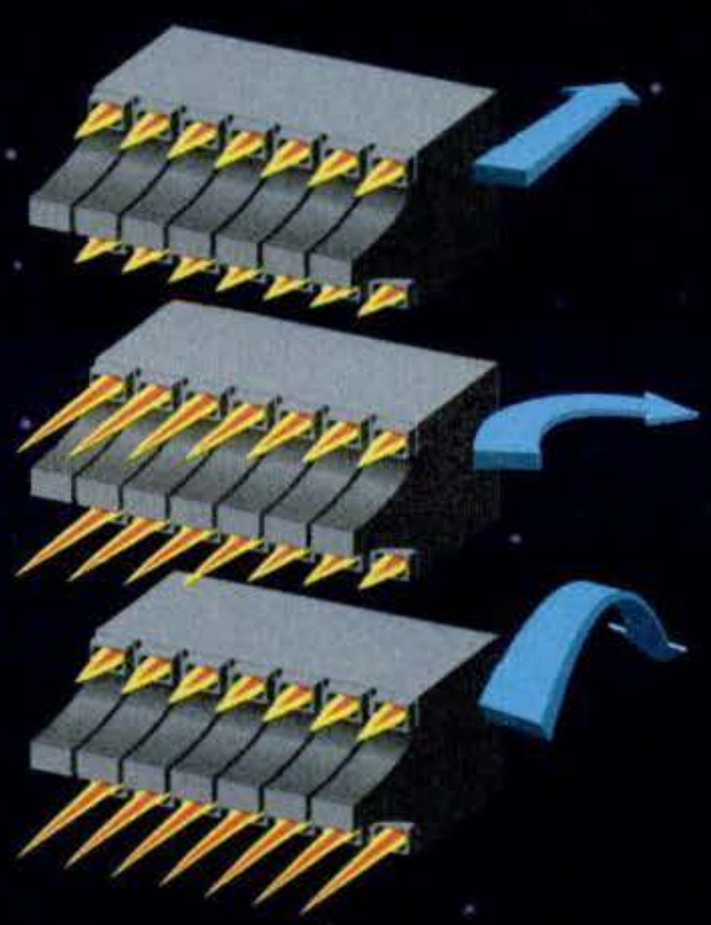
Aerospike Steering

Linear aerospike engines steer the vehicle during its ascent. In these engines, exhaust gas exits from nozzles positioned around the perimeter of a rectangular metal "spike." An automatic flight control system independently adjusts the throttles on the upper and lower modules of the seven engines to control pitch, roll, and yaw. For example, increasing the throttle for the lower modules, and decreasing it for the upper ones, makes the vehicle pitch downward.



Payload bay is removable, so satellites or other cargo can be loaded and tested before the launch date.

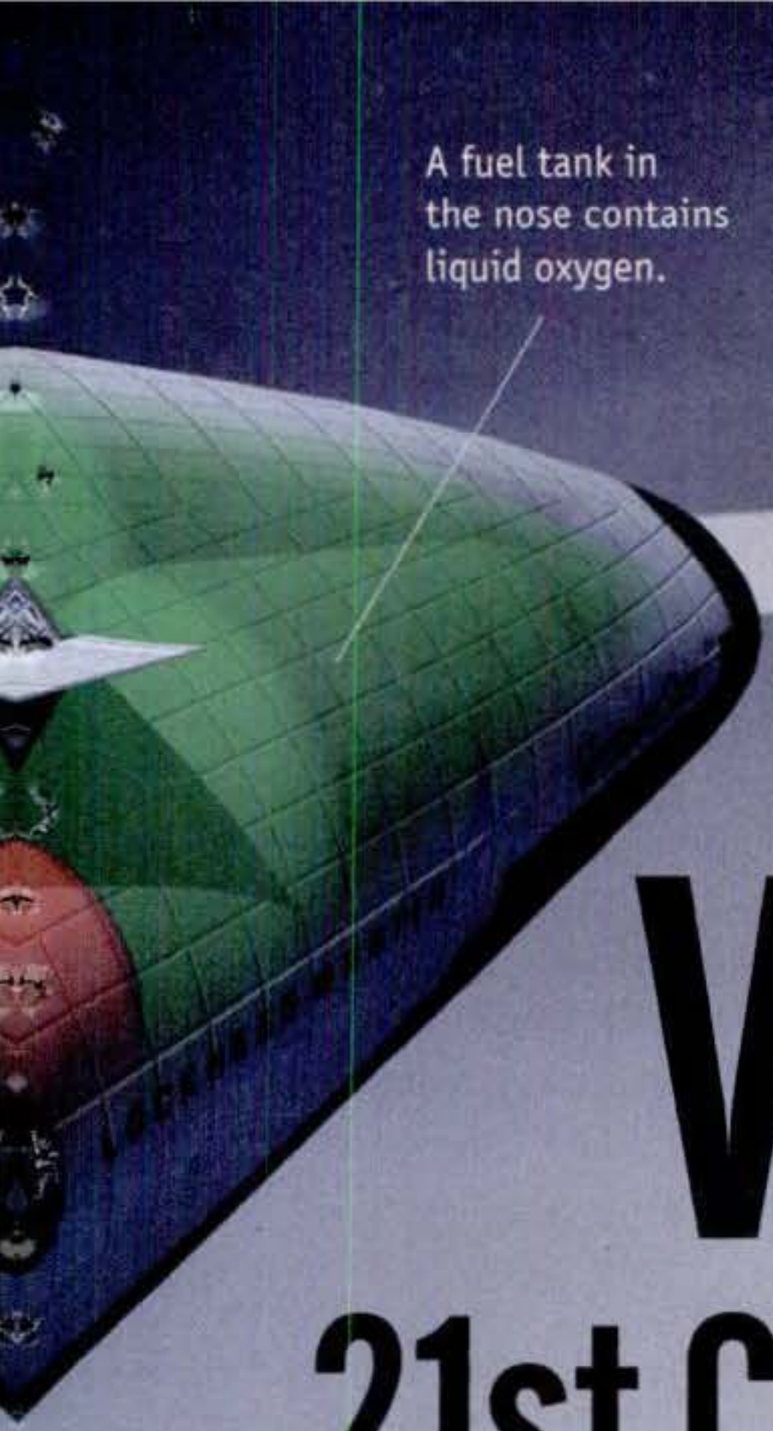
Body flaps help control flight at high speeds.

Large angled fins and small vertical fins steer the vehicle during descent and landing.

Fuel tanks made of carbon fiber contain liquid hydrogen.

VentureStar reusable launch vehicle lifts off vertically from a launch pad.

VentureStar lands horizontally on a runway.



VentureStar: 21st Century Space Shuttle

A wedge-shaped reusable rocket with a revolutionary engine will provide cheap rides to space.

By Bill Sweetman

WE HAVE SEEN THE FUTURE of space launchers, and it looks like a potato. A potato with a '61 Cadillac rear end.

That's the shape of the X-33, an experimental aerospace vehicle that will fly in early 1999, lifting off vertically like a conventional rocket, reaching speeds of more than 11,000 mph, and gliding to an airplane-runway landing. In July, NASA selected Lockheed Martin's Skunk Works to build and test the X-33. The wingless vehicle will be broad and rounded, with large stabilizing fins sprouting from its chopped-off tail. No cockpit will break its smooth contours, because the X-33 will have an autonomous flight control system instead of a pilot.

The X-33 will be a demonstration vehicle, the first step toward building a larger reusable launch vehicle called VentureStar, which will be able to lift a 40,000-pound payload into orbit at one-tenth the cost of today's launchers. VentureStar is the most likely replacement in sight for the aging Space Shuttle.

VentureStar is needed because NASA is in a trap. The agency wants a space station. To build and support it, NASA needs a launch system that can lift people

INFOGRAPHIC BY JOHN FRASSANITO & ASSOCIATES AND SLIMFILMS

	Space Shuttle	X-33	VentureStar
Launch date	1981	1999	2004
Height	184 ft.	67 ft.	127 ft.
Liftoff weight	4,500,000 lbs.	273,000 lbs.	2,186,000 lbs.

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JOHN FRASSANITO & ASSOCIATES FOR NASA AND LOCKHEED MARTIN SKUNK WORKS

VentureStar shown releasing a satellite. Its goal: to reduce cost of payload launches by 90%.

and heavy loads into space. The Space Shuttle can do both, but it costs $500 million a flight, and there are doubts about its safety. NASA needs a new launcher, but it cannot afford to build one unless it stops flying the Shuttle, a political impossibility.

In 1993, NASA Administrator Daniel Goldin set up a special commission to find a way out of the dilemma. The team concluded that the most promising solution was what some people had hoped the Shuttle would be: a reusable rocket that would go into orbit without the aid of jettisonable boosters or a throwaway fuel tank. To find the best design for such a rocket, NASA sponsored a competition. The prize: a contract to build the X-33.

From the start, there were two obvious candidates. Shuttle builder Rockwell International teamed up with Northrop Grumman to design a reusable launch vehicle that looks like a modified Shuttle, stretched to accommodate fuel tanks. McDonnell Douglas Aerospace pitched in with its Delta Clipper, shaped like an inverted ice-cream cone and designed to land vertically on stumpy legs. The third entry, from the Skunk Works, was more of a surprise, because most of the company's high-speed work had been kept under wraps.

The Skunk Works X-33 design dates back to a 1983 design study for a Shuttle-shaped, rocket-powered "trans-atmospheric vehicle" for the Air Force. The Skunk Works continued to work on this technology until mid-1988 under a classified project code-named Have Region. David Urie, the Skunk Works manager for high-speed programs, recalls that it was in the early 1990s "when I was overcome by the conviction that we were on the verge of being able to do single-stage to orbit" with a rocket. He started to put together a design that blends Have Region technology with a wingless, flattened "lifting body" glider. Lockheed Missiles & Space had studied the lifting body for NASA as a potential "lifeboat" to bring astronauts home from a space station in an emergency.

NASA selected Lockheed to build the $1 billion X-33 because its lifting-body design offered higher performance at lower cost than its rivals and because the company proposed a more extensive demonstration program for the same money. Another factor may have helped Lockheed win: The X-33 could draw some technology from secret Air Force programs.

The design of the X-33 and the way it is being built would raise this suspicion even if it were not a product of the Skunk Works, the world's premier secret-airplane shop. The X-33 relies on a number of technologies that ostensibly have never been tested in flight. Some long-time observers of NASA and Lockheed see this as strangely risky behavior. "You're seeing two organizations acting out of character," says John Pike of the Federation of American Scientists. NASA is known for cautious engineering and a resistance to untried ideas from outside its own walls, while Lockheed has resisted pressure to share in high-risk projects.

Paul Czysz, a former McDonnell Douglas engineer, points out that it usually takes at least eight years of development before a brand-new rocket engine can be used to launch a vehicle. "There *has* to be a tested engine out there," he says. Both Czysz and Pike believe that a rocket-powered aerospace vehicle has been built and flown under a secret Pentagon program. But if that's true, Lockheed is not ready to admit it.

Whatever its origins, the VentureStar design is elegantly simple. The designers' first decision was that the vehicle would lift off like a rocket and land like an airplane. Taking off from a runway would require such a heavy undercarriage that the vehicle could carry no payload. Lockheed rejected vertical landing because that would require the vehicle to carry landing fuel throughout the flight.

Lockheed designers also decided to eliminate wings. Conventional airplane shapes, Urie says, "have wings that you don't use until you land, but you have to carry them all the way up to orbit." A lifting body does not produce lift as efficiently as a wing, but this matters little because the vehicle is very light when it returns, minus its payload and fuel. VentureStar will be light enough to land on an 8,000-foot runway, shorter than the runways at most major airports.

Another advantage of the lifting body is that it has an enormous amount of internal space. This is vital for a vehicle fueled by liquid hydrogen, with its very low density. An indication of the lifting body's packaging efficiency is that the 975-ton VentureStar is roughly the same length and width as a Boeing 757 medium-range jet, but it weighs as much as two 747s.

Lockheed paired the lifting body with an engine developed by Rocketdyne. Most rocket engines have round,

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X-34: ORBITAL SCIENCES; SPACECAB: SEBASTION QUIGLEY (LINDEN ARTISTS); MAKS, BURLAK: BILL SWEETMAN

A World of Reusable Launchers

NASA'S SELECTION OF VentureStar may spell the end for McDonnell Douglas' Delta Clipper. An improved version, called the DC-XA, has flown a few times, but funding for it ran out in August. A fighter-size space plane called Black Horse may also have a hard time getting further support. Designed by a freelance team led by Air Force test pilot Capt. Mitchell Burnside Clapp, Black Horse takes off from a runway with mostly empty tanks, then meets a KC-135 tanker at 35,000 feet to fill up with fuel for the second leg of its journey. Although Black Horse and DC-XA have been eclipsed by VentureStar, several other projects are still active around the world—at least on paper.—*B.S.*

X-34

NASA's X-34 will test technologies to be used on a small commercial launcher with a payload of 1,500 pounds. The X-34 will fly in late 1998, reaching a maximum speed of Mach 8, or 5,300 mph, at 250,000 feet. Rockwell and Orbital Sciences Corp. were selected to build the X-34, but withdrew from the project after less than a year, saying it was not commercially viable. Now the project has been restarted with Orbital as the sole contractor.

MAKS

Molniya, the company that built the Russian space shuttle, has designed a delta-wing orbiter called MAKS (the Russian acronym for Multipurpose Aero-Space Plane). Perched on a 250-ton fuel tank, MAKS is carried to 35,000 feet by the world's largest airplane, the Antonov An-225. From there, it uses the new RD-701 rocket—burning kerosene, liquid hydrogen, and liquid oxygen—to reach orbit. With two crew members, it can carry an eight-ton payload. The project is stalled for lack of money.

Burlak

Another Russian project, Burlak, uses a Tupolev Tu-160 supersonic bomber as a reusable booster. The bomber carries a 28.5-ton two-stage rocket and releases it at 1,200 mph, putting as much as 2,500 pounds into orbit. Lofting a payload of that size from the ground would require a much larger booster. Launch costs will be half those of a conventional booster, according to the Russian missile company Raduga, which designed the rocket. Like MAKS, it is still waiting for funds.

SpaceCab

David Ashford, a veteran British missile designer with early experience in space launchers, founded Bristol Spaceplanes Limited to study a reusable launch system that emphasizes safety. Ashford's SpaceCab is a two-stage design. The Concorde-like first stage uses rocket boosters to reach Mach 3.4 and 140,000 feet. The all-rocket upper stage is a delta lifting body, rather like a small X-33. An unusual feature is that the structure is partly pressure-stabilized, like an inflatable boat, to save weight.

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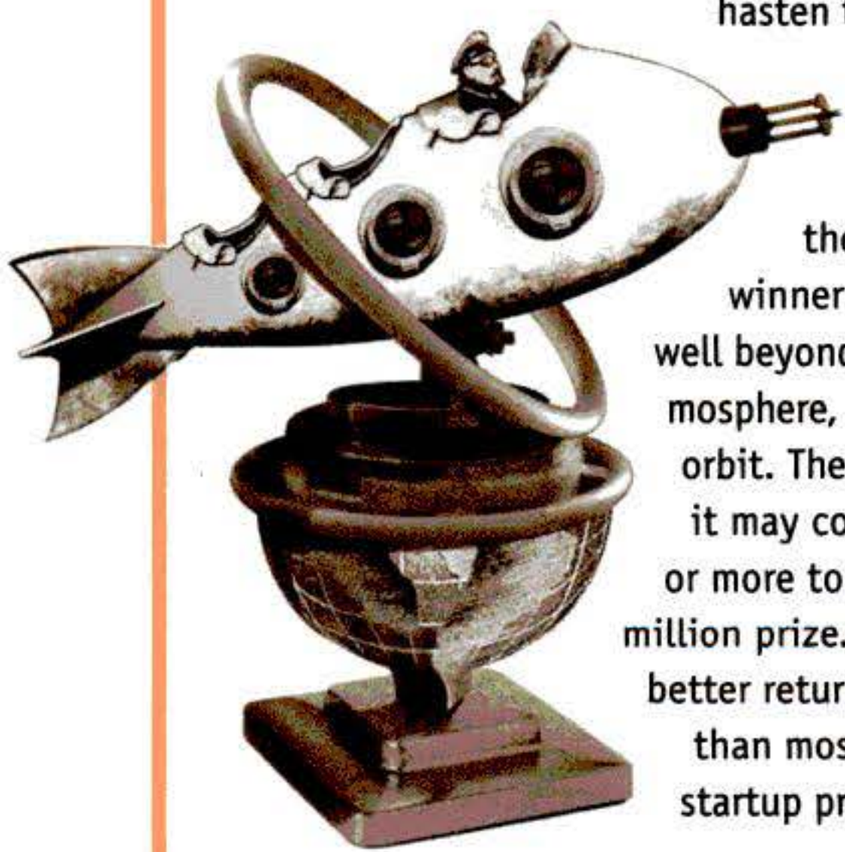
The $10 Million Carrot

SOMEDAY, SOMEHOW, a paying passenger will ride into space. Among those who believe it will happen: a group of St. Louis business leaders sponsoring the X-Prize, a $10 million award for the first passenger craft to achieve an altitude of 100 kilometers (62 miles). The basic rules: The craft must seat three adult travelers, land in reusable condition, and fly twice in 14 days. No government money can be used for the project.

Aviation prizes have a noble history. Charles Lindbergh flew across the Atlantic to win a $25,000 prize. The first human-powered aircraft to achieve sustained flight, American Paul MacCready's *Gossamer Condor*, won a prize that had been up for grabs for 20 years.

The X-Prize Foundation is the brainchild of Peter Diamandis, the founder of several aerospace businesses. Supporters include astronaut Buzz Aldrin and aircraft designer Burt Rutan. They hope the prize will hasten the arrival of a space tourism industry.



To claim the X-Prize, the winner will have to fly well beyond the Earth's atmosphere, but not into orbit. The bad news is that it may cost $100 million or more to win the $10 million prize. But that is a better return on investment than most aerospace startup projects. —*B.S.*

VICTOR KOEN

bell-shaped nozzles, which have an inherent limitation: The ideal size of the nozzle depends on the outside air pressure, so a bell nozzle will work at peak efficiency at only one altitude. In the 1960s, Rocketdyne developed a newer nozzle called an aerospike. It resembles a bell nozzle turned inside out, with the hot gas stream exiting around the perimeter of the nozzle. With this type of nozzle, as the rocket climbs, the decrease in ambient air pressure automatically changes the shape of the exhaust plume.

The first aerospikes were round, but in 1972 Rocketdyne tested a "linear aerospike" engine in which the gas stream exits along the surface of a rectangular wedge rather than a round spike. Designers hoped that the linear aerospike would power the Shuttle, but NASA opted for a more conservative design. The engine went into storage until Urie and his colleagues mated it with the lifting body for Lockheed's proposed vehicle.

VentureStar will have seven linear engines, arrayed across its entire trailing edge. The engines blend into the wing, causing less drag on descent than a cluster of round engines. Like most rockets, VentureStar is steered in its ascent phase by vectoring the thrust of the engines. But instead of moving on gimbals as conventional rockets do, VentureStar's engines are fixed. The rocket's automatic flight control system adjusts the throttles on each of the engines' upper and lower modules to steer the vehicle.

Under the rocket's carbon-fiber skin, carbon-fiber tanks on each side carry liquid hydrogen. The hydrogen tanks carry the main nose-to-tail thrust loads on takeoff. A smaller tank in the nose holds liquid oxygen, which is mixed with the hydrogen for combustion. The 45-by-15-foot payload bay is at the center of the vehicle.

VentureStar is a featherweight giant designed to lift 40,000 pounds of payload to low Earth orbit, and 25,000 pounds to the higher orbit that the space station will occupy. The airframe, engines, and flight control systems account for 9 percent of its 2.2-million-pound liftoff weight—roughly equivalent to a 20-pound racing bike carrying a 200-pound rider. Most of the vehicle's liftoff weight consists of the liquid hydrogen and oxygen.

VentureStar operations should be almost unimaginably different from today's space launches. "We took the top four man-hour-eaters on the Shuttle," Urie explains, "and said 'we're not going to do that.'" The Shuttle's solid rocket boosters, which must be fished from the sea and meticulously rebuilt after each flight, are gone. There are no heat-resistant ceramic tiles to be checked and replaced, a process that takes an astounding 17,000 man-hours for each Shuttle flight. Because the lifting body has a large surface area, it re-enters the atmosphere more gently than the Shuttle, and can use a metal heat shield instead of ceramic tiles. The Shuttle's maneuvering thrusters use hypergolic fuels, which ignite on contact; the only fuels on VentureStar are liquid hydrogen and oxygen. And VentureStar has no hydraulic system; its flight controls, doors, and landing gears are electrically powered.

Launches are often delayed when engineers discover a glitch in a satellite payload that has already been loaded onto the launcher. VentureStar won't have this problem, because the payload bay is a self-contained canister. The manufacturer will load the satellite into the canister, test it, and deliver it to the launch site, ready to fly.

With no boosters or external tanks, the cumbersome job of assembling the vehicle on a vertical tower is eliminated. VentureStar will be checked out in a hangar, like an airplane. A routine turnaround in seven days is the designers' goal. Once the vehicle is fully operational, it is likely that there will be a number of VentureStar launch and recovery sites around the world. Each site will be much smaller than today's launch complexes.

VentureStar should be fundamentally safer than today's rockets, because its design reduces the number of potentially catastrophic problems. For example, a conventional rocket is doomed if one of its engines fails in

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flight. But VentureStar's engines have an emergency thrust reserve. In the worst case, when one of the seven engines fails on liftoff, the engine opposite it will be shut down to balance the spacecraft, and the remaining five engines will be throttled up to carry the vehicle into orbit.

The reusable rocket is not only safer but also more environmentally friendly. Its exhaust consists of water vapor, rather than the chemical wastes spewed out by a solid rocket, and there is no hail of debris from spent boosters.

Lockheed is not yet ready to build VentureStar. There are still issues that the X-33 demonstration flights must resolve. The X-33 is a 53-percent scale model of VentureStar and weighs about one-eighth as much. It will not fly all the way to orbital speed, but it will be fast enough to test the aerodynamics and metal heat shield under realistic conditions. The X-33 is expected to reach Mach 3 on its first flight in 1999, a 30-mile hop from California's Edwards Air Force Base to nearby Bicycle Lake. A total of 15 flights are planned, mostly from Edwards to Malmstrom Air Force Base in Montana.

Design and construction of the full-scale VentureStar will start in early 2000, and it is expected to fly at the beginning of 2004. The second vehicle is to be the first astronaut-carrying VentureStar, which could fly in early 2006. Not many vehicles will be produced at first. If VentureStar can fly as often as it is supposed to, three or four vehicles will be able to meet NASA and Pentagon needs, plus a large slice of the U.S. and international commercial market.

Once the X-33 has finished its tests, Lockheed and its partners are on their own. NASA has no money in its budget to build the full-size VentureStar and expects private industry to foot the bill. Finding investors willing to bet $5 billion in development costs on the notoriously unpredictable space market may be as big a challenge as designing the new space plane. Lockheed may form an industry consortium, including VentureStar's builders and other spacecraft producers, to spread the risk. It won't hurt that, in August, Boeing agreed to buy Rockwell's aerospace units, including Rocketdyne, adding a second aerospace giant to the VentureStar team.

VentureStar's impact on the space business will be profound. Zero-gravity manufacturing of exotic materials could change from a curiosity into a paying business. Urie also expects that satellites will become less costly: With far lower launch costs per pound, designers won't have to build satellites from expensive, ultra-light, super-durable materials. Satellites "don't have to be immortal when you can afford to replace them more frequently," says Urie. And if satellites become less costly, they will be more widely used for tasks such as agricultural surveying and pollution monitoring.

VentureStar's goal is to reduce the cost of launching payloads into space by 80 to 90 percent, to about $1,000 per pound. But to convince potential customers that VentureStar can be built and flown on time and within budget, Lockheed will first have to do the same with the X-33—and 32 months is not a lot of time. "Am I comfortable with the schedule?" asks Urie. "It's like bungee jumping. At the point where you go off the platform, you're comfortable."◆

JOHN FRASSANITO & ASSOCIATES FOR NASA AND LOCKHEED MARTIN SKUNK WORKS

VentureStar will be able to carry 25,000 pound payloads to space stations like the one it is docking with here. Astronaut-carrying VentureStars could fly by as early as 2006.

VentureStar's goal is to reduce the cost of launching payloads into space by 80 to 90 percent.

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Surf television channels and the Internet on the same tube.

Web tv

By Chris O'Malley

Web browsers, like this one used by Zenith's Inteq, are optimized for displaying computer signals on TV monitors–with surprisingly good results.

BY MOST CRITERIA, it was a Norman Rockwell-style evening at home. Just finished with dinner, the two older children were in the yard throwing ragged tennis balls to the golden retriever. The baby was fast asleep on a blanket spread across the family room rug.

PHOTO-ILLUSTRATION BY DAVID McGLYNN

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And behind her, Mom and Dad sat watching their big-screen TV, browsing for scenic New England vacation spots on the Internet.

Wait a minute. What about that Internet thing? Safe to say, we were the first on our block—and among the first in the country—to kick back on the couch and flip through the pages of the World Wide Web with a remote control and a 31-inch screen. But our distinction is temporary. Computer and electronics companies are gearing up to sell America real products that finally deliver on the long-vaporous convergence of television and the Internet.

Of course, the reality of Web TV takes some getting used to. "Excuse me," announces the 7-year-old, returning to the bosom of her family at precisely 6:30 p.m. "It's time to watch 'Rugrats' on Nickelodeon." Her 4-year-old brother races in closely behind. "Yeah, the one where the pictures move fast," he adds, distinguishing—rather saliently—between Nickelodeon's TV channel and Web site.

For millions of adults (and older kids), Web TV should prove to be a more intriguing experience. Contrary to the solitary confinement of most computer activities, plenty of Web site offerings now invite an audience of two or more, from vacation-planning programs and news feeds to music samplers and online games. The content of Web pages is frequently less than compelling (not unlike Saturday night TV), but putting them on a big screen where more than one person can view them, and where you can leaf through the "pages" from the comfort of your couch, certainly doesn't hurt their appeal. And—without getting up from the sofa—you can quickly send reviews and comments to friends via e-mail.

Pairing the Web and television can make plenty of economic sense, too, especially for those who have yet to invest in a home PC that can be easily (and willingly) shared by everyone in the house. The cost of adding Web access to your TV or buying a new one with an Internet link varies, but the premium is generally $200 to $500. That's no bargain if you have little use for the Web outside your home office, but it's a far cry from buying a new PC just for surfing the Net.

Actually, Web TV cannot be defined as a singular experience; nor can it be associated with only one type of product. Several companies, including Sony and Philips, are (or soon will be) selling set-top boxes containing modems and Web browsing software that enable you to surf the Net with your current TV. Others, such as Japanese electronics makers Bandai and JCC, are selling beefier boxes with CD-ROM drives that you hook up to your TV for Web access. Zenith, Samsung, and others are taking the technology inside, incorporating the modems and software into TV sets. Sega has introduced a Net Link cartridge and phone line connection for its Saturn videogame system; Nintendo says it plans something similar. And Gateway's groundbreaking Destination, which meshes a full-throttle PC and full-size TV screen, will soon be challenged by a joint PC-TV product from Compaq Computer and Thomson's RCA division.

Still more permutations are on the way. TV makers say there's no reason the same Web-dialing technology couldn't be built into VCRs—a move that might finally make the picture-in-picture feature on new TVs useful. Just imagine watching a football game and being able to check player statistics on the Internet at the same time.

Many cable TV companies plan to offer new digital set-top boxes for Internet access after the companies' one-way broadcast networks have been upgraded to handle two-way data traffic. Meanwhile, several computer hardware and software makers, including Digital Equipment and Oracle, have developed prototypes of

Webster is an add-on box providing Internet access.

Zenith offers a web browser built into its Inteq TVs.

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so-called network computers, or NCs—essentially stripped-down, low-cost PCs whose software and processing power come from the Internet. These NCs might be cabled to TVs rather than use monitors of their own.

Technically, this mating game is not quite as easy as it sounds. Just plugging it all in can be a challenge. While nearly all of the products being introduced or envisioned to date use standard 28.8Kbps or better modems that plug into existing analog phone lines, many family or living rooms don't have a phone jack—or don't have one that's near the TV. So be prepared to run some wire or use a wireless telephone jack extension, which is available as an extra with some systems.

A cable **TV connection** for data (with a cable modem) would greatly accelerate the flow of Web pages across the screen and make for more convenient connections. But practical cable modems and the networks to support them may still be two or three years away. Ditto for widespread, affordable digital (ISDN) phone service.

Displaying Web pages on a television screen is not as easy as plugging a video output cable into the back of a TV set, either—at least not for the engineers who design these systems. Under the current NTSC broadcasting rules, TV images are beamed to the screen using a system of 60 half-frames per second. (Every other line is illuminated.) This "interlaced" display system effectively conveys the illusion of 30 full frames of motion video per second. But computer monitors use a "noninterlaced" system that continually displays all lines from top to bottom and is much better suited to finely detailed images and close-up

Bringing the TV to Your PC

THE MOVE toward TVs that let you surf the Web has stolen the thunder from another highly touted convergence plan, Intel's Intercast system, which simultaneously delivers TV broadcasts and Web pages to your PC. Indeed, the many fledgling Web TV efforts raise anew a key question about the Intercast approach: Is sitting in front of a PC screen any way to watch TV?

The Intercast system, which was announced last year but only recently approved by the FCC, piggybacks Web pages with regular TV broadcasts by transmitting the data within the "vertical blanking interval" portion of the television signal. The idea is to couple TV shows and related information in the form of Web pages. For example: A news broadcast can be paired with more detailed news accounts, and they both can be viewed together on a PC screen.

But the ability to tap into the Internet easily from your big-screen TV may give you another reason to say no to "intercasting." There are several obvious disadvantages to viewing TV programs on a computer: PCs typically have small screens (14 to 17 inches, diagonally) and often rest on desktops in home offices or dens, which may not be equipped with cable TV outlets. Other obstacles are less apparent. The Intercast system requires that you add a special TV tuner and data decoder card to your PC (or buy a PC that includes one). Even then, you receive only a handful of selected Web pages, not access to the entire World Wide Web.

The Intercast system, is backed by a diverse group of interests, including broadcasters such as NBC, QVC, Turner, and Viacom, as well as computer companies such as America Online, Compaq, Gateway 2000, Netscape, Packard Bell, and, naturally, Intel.

Ultimately, though, only compelling content will likely sell viewers on the Intercast notion. NBC says it plans to use it for some of its prime-time lineup this fall, beginning with an "interactive crime lab" to accompany the broadcast of "Homicide: Life on the Street." Viacom says it plans to use the system with its new MTV offshoot, called M2, to pair music videos with related Web pages. Smashing Pumpkins, anyone?—*C.O.*

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viewing, where interlacing can show noticeable flickering. Also, computer monitors typically display pictures at much higher resolutions than TVs, and with a better range of color.

The two systems are not compatible, but the gulf can be bridged. One way is to convert the digital computer signals (or VGA signals) to analog NTSC format, which is far easier said than done. VGA-to-NTSC converters have been around for years, but picture flicker and fuzzy text persist, in many cases, at even the base VGA resolution of 640 by 480 pixels. And those problems get worse with the higher Super VGA (800 by 600) or XGA (1,024 by 768) resolutions that are better suited to filling out big screens. Another option: digitizing NTSC signals and displaying them on a large computer monitor. That conversion has its own negative side effects (jagged edges and color dropouts among them), and big-screen computer monitors can be very expensive.

Because of these technical differences, text that's easy to read on a PC monitor is difficult to read on a TV, especially when you view it from a distance. Pictures that look sharp on a PC monitor can appear grainy on a TV. Without some alterations, some Web pages are too wide for the TV screen, too, forcing you to scroll horizontally as well as vertically—a process that quickly grows tiresome.

Other challenges arise as well. A remote control with a tiny trackball or directional buttons can move the pointer around the TV screen, but how do you type in text? What about printing Web pages or saving them to a disk? And how do you make getting onto and navigating the chaotic Web easy enough for anyone to handle?

One of the most promising early attempts at clearing these and other hurdles is the WebTV set-top box solution devised by WebTV Networks of Palo Alto, California. An upstart company founded by three Apple Computer alumni, WebTV Networks (*http://webtv.net*) has already licensed its technology to Sony and Philips, which each plans to sell the WebTV system under its own name this fall for about $300. WebTV Networks will run the Internet service that feeds Web pages to the boxes. The subscriber's cost is expected to be $19.95 a month for unlimited use.

WebTV's hardware is unassuming enough: a set-top box that connects to the TV and a phone outlet, a remote control unit, and an optional wireless keyboard. (There is also a port for a standard PC keyboard.) But the proprietary hardware within does a remarkable job of converting Web data into a crisp, readable TV display viewable from a distance. Words are uniformly clear, graphics are colorful and sharp, and pages are properly formatted for the TV screen, with no visible flicker whatever.

The WebTV system's real coup, however, may lie in its elegantly simple interface and browsing software. It does a better job than any system to date—on a TV or PC—of putting a friendly face and an easy handle on the World Wide Web. An automated registration system sets up your Internet account and assigns your system a local phone number for dial-up access. A WebTV home screen lets you call up a favorite Web page, search the Web, or choose from a directory of categories (sports, kids, news, and so on). Local content—initially for 50 metropolitan areas—relating to restaurants, schools, and events will be available under an "Around Town" designation. You can do all of this, plus send e-mail, with the remote control. An onscreen keyboard appears if you want to type in a Web address or an e-mail message without a keyboard.

Indeed, the killer application—as the computer folks like to say—may just be e-mail. The idea of quickly jotting off a note that's delivered almost instantly is extremely appealing and certainly beats hunting around for a stamp. Checking for incoming mail is a snap as well. With WebTV, for example, the machine periodically dials in for messages, lighting up an LED on the box when new mail has arrived.

WebTV is fraught with thoughtful touches. In addition to a "back" button on the remote for retreating to the previous page, a "recent" button shows thumbnail pictures and descriptions of the last several pages you've visited. And when a phone on the same line is picked up, or a call-waiting tone is detected, WebTV disconnects temporarily and then reconnects where you left off.

Clearly, an eye is cast toward the future here as well. A slot on

Magnavox and Sony will be using WebTV's browser.

A pop-in cartridge converts Sega's Saturn game system into an Internet provider.

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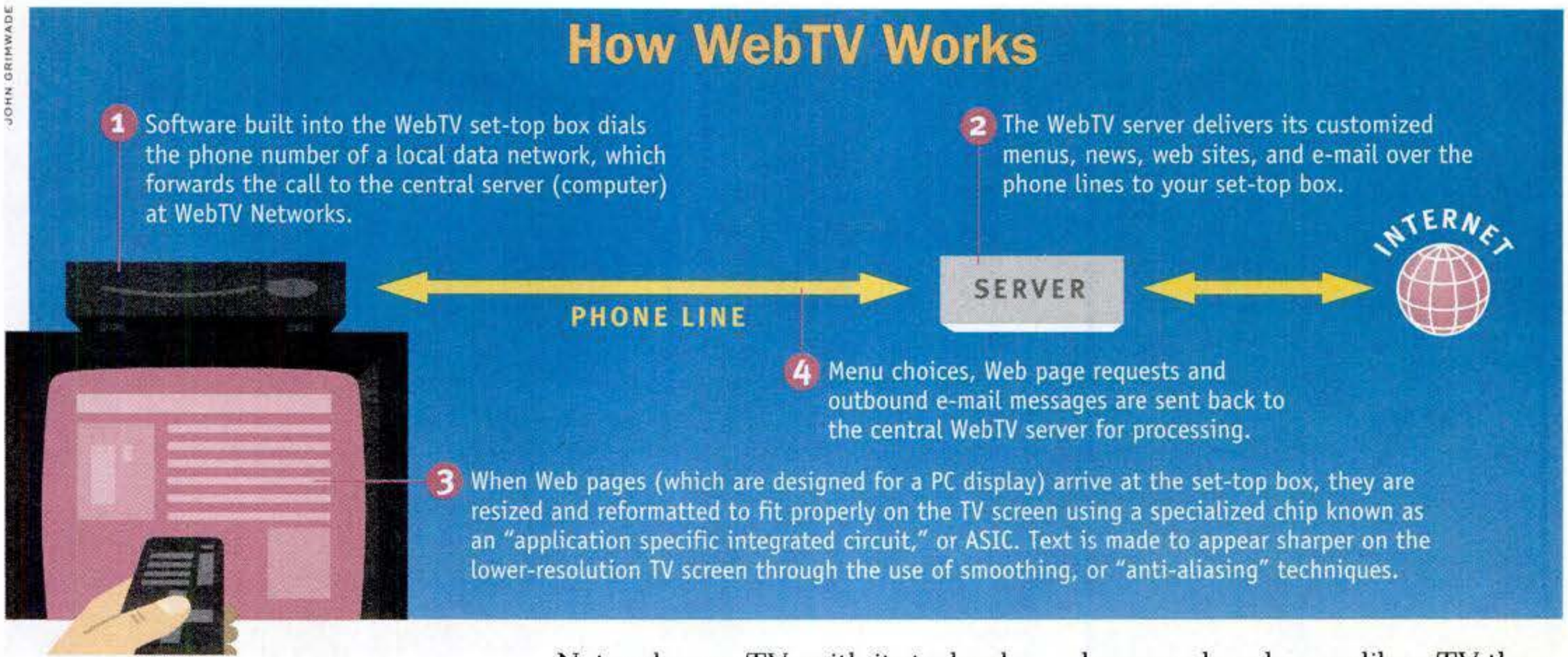

JOHN GRIMWADE

the front of the box will enable it to read future "smart cards" for performing transactions or accessing another WebTV system (in a hotel room, for example). And an expansion connector on the side of the unit is intended to make room for an ISDN adapter, a cable modem, and/or a video capture card so you can hook a video camera to the system. This port will also be used for a peripheral that would allow you to connect a printer.

WebTV is not a perfect model for Internet access via the TV. Data cannot be saved to a disk, and a built-in port for a printer would make more sense. And you don't get to choose your Internet service provider—it's WebTV or bust.

Using WebTV Networks is hardly the only way TV makers can get a leg up. ViewCall America of Norcross, Georgia, has designed a similar three-piece setup (set-top box, remote, and wireless keyboard) called Webster, which is also expected to retail for about $300. While its software may not be as impressive as WebTV's, the Webster box does offer a parallel port for cabling a printer to the system. JCC's iBox (about $500) takes the concept a bit further with a proprietary CD-ROM system, more memory, and ports for hooking up printers, floppy drives, and high-capacity Iomega Zip drives.

Eventually, the key to bringing the Web to the masses may be Internet access that would be standard inside a new generation of TVs. WebTV Networks says TVs with its technology built-in will be available next year—Sony and Philips appear to be likely candidates. Zenith is starting even sooner, with a new line of NetVision sets that use a Web-dialing system developed by Diba Inc., a Menlo Park, California, company that develops designs for specialized "information appliances". Zenith has already announced 27-inch ($1,000) and 35-inch ($3,500) models, with the latter being sold under its new Inteq brand.

NetVision sets each use a 28.8Kbps modem; when cable modems become available, you will be able to connect them through a high-speed Ethernet jack. The sets also come with an infrared remote that has an embedded trackball, and a wireless keyboard is optional. Samsung plans to incorporate the Diba technology into some of its TVs as well.

Curtis Mathes says it will offer a text-only Internet browser dubbed UniView in 32-, 35-, and 50-inch sets by year's end for roughly $300 more than regular sets. Mitsubishi and Hitachi say they will begin selling Web TVs this year, too, but have yet to reveal any details.

Thomson, makers of the RCA brand, says it plans to test the Web waters first with a full-fledged PC-TV product similar to Gateway's Destination, which pairs a Pentium PC with a 31-inch monitor and special electronics for displaying TV as well as computer data. The Compaq-RCA product will use a screen that is 31 inches or larger and work more like a TV than a PC, according to Thomson. When the system is turned on, it will come up in TV mode, instead of booting up Windows 95 as Destination does.

Thomson says it may offer several versions of its PC-TV with Compaq, with prices in the $3,000 to $5,000 range. The first model is expected to be available early next year.

Several big shoes have yet to drop in the Web TV race. Matsushita, maker of Panasonic and Technics brands, has yet to say when or if it might sell a cyber-ready TV or set-top box. Cable TV companies such as TCI and Time Warner are currently testing cable-based Web TV products. And on the computer side, Microsoft is working on interactive TV technologies of its own.

But the most important shoes, as always, belong to you. Is browsing the Web on your TV worth an extra $300 to $500? Maybe not, particularly if you already have a pipeline to the Internet in the next room. But more than half of all households still don't have a PC, and nearly all of them have TVs. Then again, some PC owners might find a second, relatively inexpensive route to the Internet attractive. And while it's hard to pin a value on the Internet, merely seeing what all the fuss is about—and joining the global e-mail community—may be worth the price of admission.

At the very least, it should make for some interesting conversations around the tube. Provided "Rugrats" isn't on, that is. ◆

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5 year New Car Preview

Here's what's happening and what's not as carmakers face the millennium.

By Tony Swan

WE'RE ROLLING INTO the American automobile's second century and peering into the next millennium, but the business-as-usual attitude of automakers seems out of step with such mileposts.

At General Motors, for example, family sedans and minivans dominate the 1997 model year, They're more contemporary and distinctly better than the vehicles they replace, but they're not exactly harbingers of a new age in technology.

And the leading-edge research programs likely to create reasonably practical electric cars or breakthroughs in mileage? They're three to five years away from presenting workable prototypes. One exception: GM is pushing forward with its plan to build and market an electric car.

Other automakers are putting EVs into service in 1997, in limited fleet-evaluation applications but with substantially more advanced batteries than GM's. But the GM entry will be the first EV to reach the dealerships. Changes to GM's mainstream line are less dramatic, however.

H.G. LEHMANN/HIDDEN IMAGE

Dodge plans Dakota-based SUV for 1998.

General Motors The GM car that will get the most attention in '97 will have two seats and a lot of horsepower—the '97 Corvette. This new 'Vette represents the first major redesign since the current-generation car was launched 13 years ago.

GM also has fully re-engineered its mid-size and large-car platforms, setting the stage for its next decade with products that are simpler, stronger, and better-handling than their predecessors. GM is sticking with a series of two-valve pushrod engines, unlike its competitors' multi-valve, overhead-cam offerings.

Among smaller GM offerings, Chevrolet's Malibu for '97 shares a chassis with the Oldsmobile Cutlass. This Ford Taurus-sized chassis also appears, with varying dimensions, in the new Pontiac Grand Prix and Buick Century, along with differences in suspension tuning and powertrains.

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Buick's full-size Park Avenue Ultra will ride on a slightly modified version of the Riveria/Aurora platform, arguably the best in GM's big car collection.

The Saturn Coupe's exterior will be restyled, and Cadillac will launch its Opel Omega-based Catera experiment.

H. G. LEHMANN/HIDDEN IMAGE

Mid-engined Porsche Boxster due mid-'97.

GM hopes to capture more of the minivan market with its trio of redesigned front-drivers: the Pontiac Trans Sport, Oldsmobile Silhouette, and Chevrolet Venture.

Ford The Expedition joins Ford's sport-utility lineup, replacing the Bronco. Ford will follow up its mid-'96 launch of the compact Escort/Mercury Tracer sedans and wagons with a coupe version. Ford is also planning a series of ventures that will integrate its U.S. and European operations. A new big-car platform shared with Jaguar is a good example, as is a small car that will be made in Europe and sold here and overseas.

Chrysler With the first major redesign of its full-size LH sedans still nearly a year away, Chrysler's major new entry for the '97 model year is the redesigned Dodge Dakota midsize pickup truck.

Chrysler's other newcomer for 1997—the Plymouth Prowler retro-look roadster—won't have a measurable bottom-line impact, but it's guaranteed to provide some visibility for the automaker.

A much-needed Jeep Cherokee upgrade includes a modest facelift, a cab equipped with dual airbags, and retuning for a smoother ride and more precise steering.

Imports Asian automakers are consolidating their models and moving from sporty cars to sport utilities.

Among the Asians, Toyota will be the busiest in 1997, with a redesign of its Camry family. The Camry platform will be adapted for a new Lexus ES 300, with front drive slated to replace rear drive in the Previa for 1998. Toyota also is constructing a new U.S. factory for the T100 full-size pickup; a new V8 will become one of the T100's engine options in 1998.

Honda joins the mini-sport-utility derby late this year with the Civic-based CR-V. The sporty Prelude coupe will get a complete overhaul.

Nissan is repositioning and retrenching as it turns its attention to mainstream cars. The 300 ZX sport—long the critical factor in projecting Nissan's image—will be gone, and the mid-size Altima will be updated by the manufacturer.

Mitsubishi's flagship Diamante sedan will be extensively updated for '97, with the mid-size Galant due for a major makeover for '98.

Subaru and Isuzu plan updated sport utilities, while Hyundai will replace the sporty Scoupe with the all-new Tiburon sports coupe.

A coupe version of Mazda's Miata may join the lineup in 1998, but the RX-7 sports car series will be discontinued, and the future for Mazda's midsize MX-6 sport and the large 929 sedan is uncertain.

Sporty cars may be disappearing from Asian lineups, but they're enjoying a renaissance in Europe. BMW plans a six-cylinder upgrade for the Z-3, joining brand-new Jaguar, Mercedes, and Porsche roadsters—the biggest single-year changeover in history for these famous marques. Audi plans production versions of the TT Coupe and Spider in 1998.

H. G. LEHMANN/HIDDEN IMAGE

All-new Corvette features 340-hp aluminum V8.

Volvo is responding with an all-wheel-drive wagon in its lineup for 1998, and a sporty coupe and convertible for 1999. Audi will bring its aluminum-intensive V8-powered A8 flagship sedan to the United States for 1997, while Mercedes is readying smaller, lighter replacements for its lordly S-class entries, due in 1999. Mercedes is also putting the finishing touches on its AAV sport-utility vehicle, to be assembled in its new plant in Alabama. ◆

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Model	1997	1998	1999	2000
Acura				
Integra	New design with new alpha-numeric name			
CL	U.S.-built 3.0L	V6 engine option		Facelift due
TL			Facelift due	
RL				Facelift due
NSX		Uncertain future for mid-engined sports car		
SLX SUV			Major redesign expected	
Aston Martin				
DB7	Convertible joins lineup			
Lagonda		Vignale limo due		
Audi				
A3	VW Golf-based subcompact bows in Europe			
A4	Avant wagon possible for U.S. lineup			
A6/S6		CVT added to powertrain options	Redesign due	
A8	Aluminum-intensive V8 luxury sedan due	300-hp coupe version planned		
TT/TS		Concept 2-seaters reach production	2-seat coupe, roadster due in U.S.	
Bentley				
Brooklands/ Brooklands LWB		Redesign due with BMW V8 engines		
Turbo R/RL				
Continental				
Azure		Java convertible still planned		
BMW				
Z-3	190-hp 2.8L I6 engine option	Coupe version expected		
3-Series		Major redesign due	New convertible, hatchback models due	
5-Series	Sport version joins 540i models; side airbags			
7-Series	Side airbags		Airbag for head protection	Updates due
8-Series	Side airbags model	Possible convertible	Airbag for head protection	Redesign due
Buick				
Skylark		All-new car on new platform		
Century	All-new midsize sedan			
Regal		Major redesign due		
LeSabre	Minor mid-year facelift		Major redesign on Aurora platform	
Park Avenue	All-new sedans ride Riviera platform		Facelift due	
Riviera		Facelift due		

New Montero Sport is smaller, cheaper.

Model	1997	1998	1999	2000
Cadillac				
Catera	Opel-based rear-drive midsize sedan arrives			U.S.-built replacement expected
Seville		Major redesign on Aurora platform		
Eldorado		Major redesign due		
DeVille/ Concours	Side airbags added	All-new design on Aurora platform		

Sporty cars may be disappearing from Asian lineups, but they're enjoying a re-naissance in Europe.

Model	1997	1998	1999	2000
Chevrolet				
Cavalier			Minor facelift due	
Malibu	All-new small midsize replaces Corsica sedan		Interim updates due	
Lumina	Sporty LTZ joins lineup; 215-hp 3.4L V6 option	Interim cosmetic updates		Major redesign due
Monte Carlo		Interim cosmetic updates	All-new coupe on Malibu platform	
Camaro	Camaro is 30; anniversary edition offered	Lower-hp version of Corvette LS-1 V8		
Corvette	All-new 'Vette due in November; 345-hp aluminum LS-1 V8	New convertible follows coupe		
Venture	New minivan with 4th-door option replaces Lumina APV			
Astro		Dual airbags		
Express/ Chevy Van	First new full-size van since 1970 finally on sale	Dual Airbags		
S-Series Pickup	Electric-powered model offered			
C/K Pickup	Passenger airbag for models below 8,550-lb. GVWR		All-new truck includes 4-door model	
Blazer	Sporty ZR2 4x4 joins lineup			
Tahoe	Passenger airbag offered mid-year	Police model		
Suburban	Passenger airbag			
Chrysler				
Cirrus			Facelift due	
Sebring			Facelift due	
Concorde		Major redesign due for LH sedans		
LHS			Major redesign for LH flagship	
Town & Country			Interim freshening	
Dodge				
Neon		Minor detail updates		
Avenger			Facelift due	
Stratus			Facelift due	
Intrepid		Major redesign due for LH sedans		

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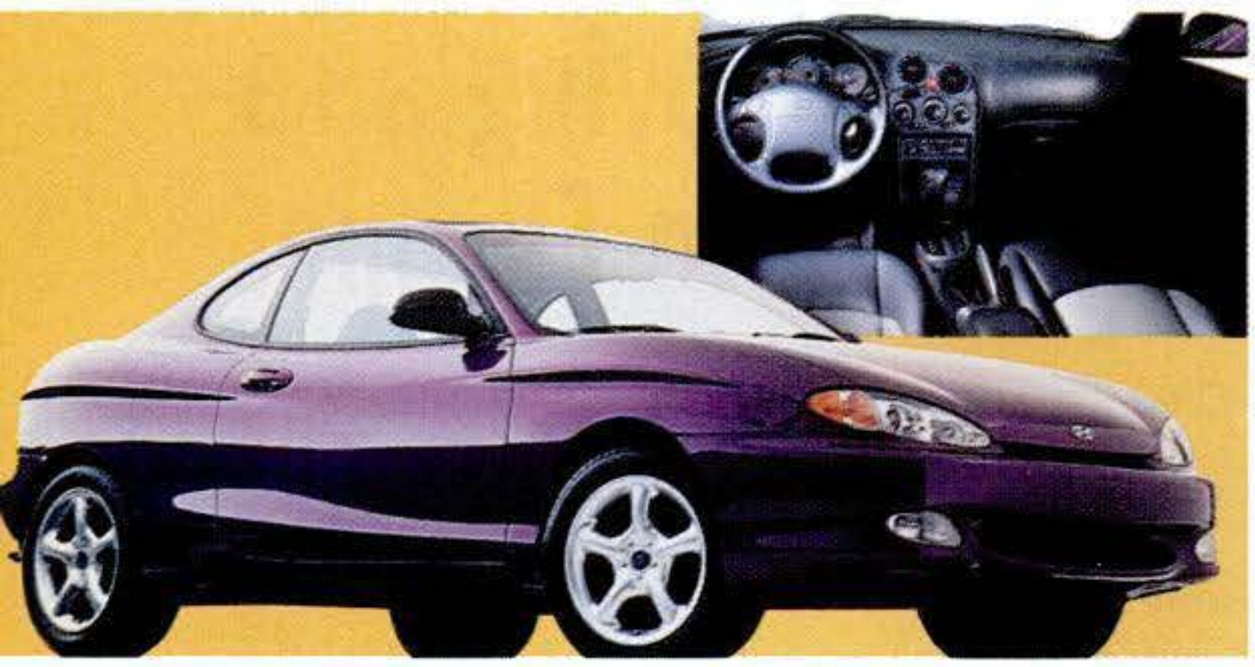
Model	1997	1998	1999	2000
Viper	GTS coupe joins lineup			
Caravan	All-wheel drive available		Interim freshening	
Dakota Pickup	Major "mini-Ram" redesign	SUV planned for Dakota chassis		
Ram Pickup		4-door option planned for Club Cab		

Eagle

Vision		All-new replacement due		
Talon		Possible convertible option		

Ferrari

F355				
F512M		Front-engined redesign due mid-'97		
F50				
456GT				



Hyundai Tiburon enters the sport coupe field.

Ford

Aspire	Minor trim updates		Major redesign emphasizes aerodynamics		**2001**
Escort	Coupe joins new sedan, wagon	Sporty SVT coupe planned		All-new Escort due on new platform	Small Escort-based SUV planned
Probe		All-new design based on Contour platform			
Contour	190-hp SVT editon planned	Facelift planned for mid-year intro	Major redesign expected		
Mustang		Facelift due			
Thunderbird			Taurus-based front-drive replacement due		
Taurus		Mid-term facelift			
Crown Victoria			All-new front-drive large car		
Windstar	Final year for rear-drive Aerostar	"Super door" due mid-'97	Redesign planned with 4th-door option		
Econoline Van/ Club Wagon	Extensive revisions; 265-hp 6.8L V10 added				
Explorer	205-hp O.C. 4.0L V6 joins powertrain lineup		Interim updates due		
Expedition	All-new full-size 4-door SUV replaces Bronco		V10 engine option		
Ranger Pickup	5-speed automatic transmission option				
F-Series Pickup	F-250, 5.4L V8 join lineup	Heavy-duty F-350 due	V10 engine option for F-350		

Geo

Metro		Modest facelift expected		
Prizm		Extensive updates		
Tracker	Special off-road package for 5-door wagon	Dual Airbags		

Model	1997	1998	1999	2000

GMC Truck

Jimmy		Dual airbags		
Yukon	Passenger airbag			
Suburban	Passenger airbag			
Sonoma Pickup		Dual airbags		
Sierra C/K Pickup	Passenger airbag for models below 8,550-lb. GVWR		All-new truck includes 4-door model	

Honda

Civic	CVT transmission option arrives mid-year	CNG model planned	Facelift, mechanical updates	
Del Sol	Redesign due			
Accord		Wide-body redesign due for U.S.		
Prelude	Major redesign, 200-hp 2.2L I4 VTEC engine			
Odyssey Minivan		Possible V6 engine option	New, larger minivan expected	
CR-V	Civic-based AWD SUV debuts			
Passport		Extensive redesign due		
EV	Honda electric subcompact set for spring intro		Possible consumer model	

Hyundai

Accent			Interim facelift due	
Tiburon	New sporty coupe replaces Scoupe			
Elantra			Facelift due	
Sonata	Facelift due	All-new Hyundai 3.0L V6 replaces Mitsubishi V6	Redesign due	

Infiniti

G20	Exterior, interior updates expected			
I30			Facelift due	
J30		Iffy future for rear-drive sedan		
Q45	Major redesign with 270-hp 4.1L V8			
QX4	New luxury SUV based on Nissan Pathfinder			

Isuzu

Oasis Minivan		Possible V6 engine option	All-new Honda-based van due	
Rodeo		Extensive redesign due		
Trooper			Major redesign expected	
Hombre Pickup		Dual airbags		

Jaguar

XK8	All-new 4.0L V8 sports cars replace XJS			
XJ6/XJ12		New V6 engine replaces inline 6		
X200			All-new sedan planned on new Ford platform	

Jeep

Wrangler	Major redesign debuts mid-year			
Cherokee	Facelift, interior redesign			
Grand Cherokee			Extensive redesign due	

Kia

Sephia	New 2.0L engine, dual airbags			
Credos		All-new midsize sedan	V6 engine option	
Sportage	Industry's first knee airbag	Dual airbags	Facelift due	

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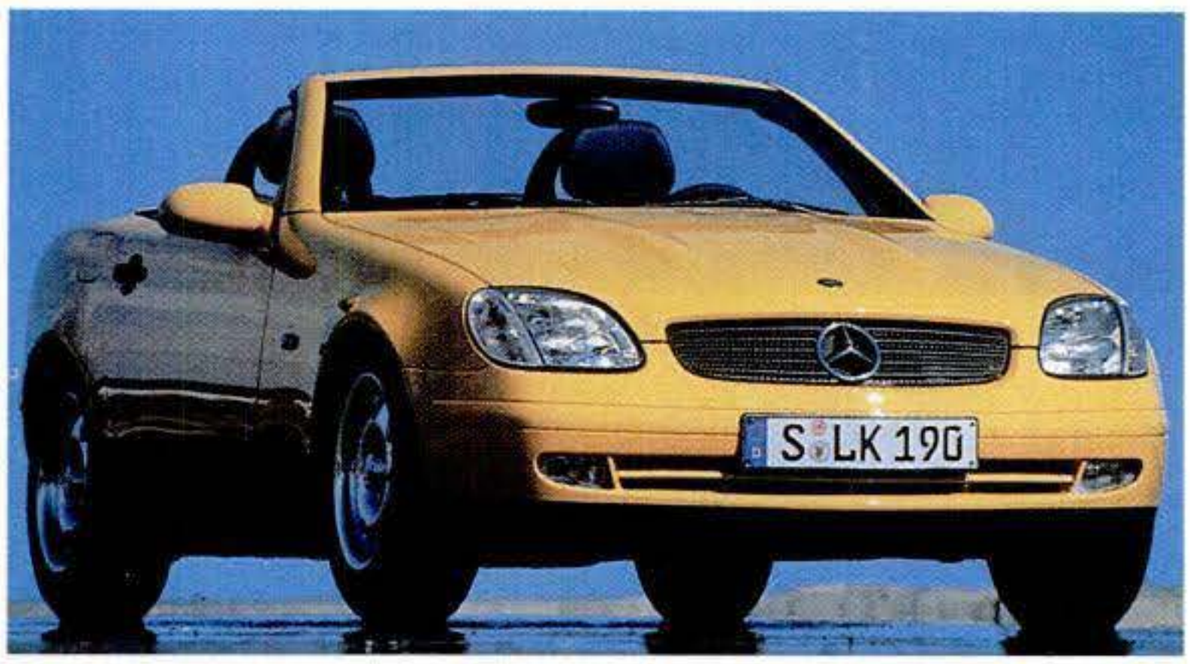
Model	1997	1998	1999	2000
Lamborghini				
Diablo	Convertible spider model debuts	620-hp Jota supercar planned	New Vector model expected	
Land Rover				
Defender 90	Wrangler-sized hardtop SUV returns; 182-hp model joins 4.0L V8, 4-speed auto	Convertible line		
Discovery				
Range Rover 4.0 SE/4.6 HSE			Possible upgrade to BMW V8 engines	
CB40		All-new small SUV due mid-year		
Lexus				
ES 300	Major redesign due			
SC 300/400	All-new coupes due	Possible SC convertible		
GS 300		All-new replacement expected		
LS 400		Interim cosmetic updates		
LX 450				



Mercedes is downsizing its sports cars, including the new SLK.

Model	1997	1998	1999	2000
Lincoln				
Continental		Minor freshening due	Small	Taurus-based Lincoln planned
Mark VIII	Modest front, rear restyling			
Town Car		All-new Town Car planned		
Navigator		New full-size SUV based on Ford Expedition	V10 engine option	
Lotus				
Elise			Small 2-seat roadster planned	
Esprit	New V8 replaces turbo I4			
Mazda				
Protege		Interim facelift due		All-new Escort-based replacement
626		Major redesign planned		
Millenia		Cosmetic updates due		
MX-6		Possible redesign based on Ford Contour		
MX-5 Miata	Extensive redesign due at mid-year	Possible coupe version		
MPV				
B2 Pickup				
Mercedes-Benz				
A-Class		All-new minicar on sale in Europe	Possible U.S. launch for minicar	
C-Class		Sporty CLK coupe, convertible planned	All-new C-Class cars due	

Model	1997	1998	1999	2000
E-Class		Wagon joins E-Class lineup	350-hp AMG E50 sport sedan	
S-Class		All-new smaller, lighter flagship sedans	Smaller CL coupe replaces S-Class coupe	
SL-Class		New supercharged SLK roadster debuts	SL coupe, roadster lose mass in redesign	
M-Class		U.S.-built midsize	SUV debuts	
Mercury				
Tracer	Coupe joins lineup			All-new Tracer on new Euro platform
Mystique		Major facelift planned		
Sable		Mid-term facelift		
Grand Marquis			All-new front-drive large car	
Cougar			Front-drive Taurus-based replacement due	
Villager			Ford, Nissan plan major redesign	
Mountaineer	5.0L V8 Explorer-based SUV debuts mid-year			
Mitsubishi				
Mirage		Redesign due		
Eclipse	Convertible Spyder debuts mid-year			
Galant	Major redesign for midsize sedan		Cosmetic detail updates	
Diamante	Larger replacement due for flagship sedan			
3000 GT		Redesign due; future iffy		
Montero	All-new luxury SUV expected			
Nissan				
Sentra		Minor facelift due	Major redesign due	
Altima	Modest redesign due		Major redesign due	
Maxima		Interim freshening	All-new Maxima due	
200SX		Doubtful future for sporty coupe		
240SX	Final year for rear-drive sporty coupe?			
Quest			Ford, Nissan plan major redesign	
Pathfinder	All-new SUV arrives mid-year			
Pickup	New pickup due with 3.3L V6			

2001
Major redesign expected

Olds '97 Cutlass: one of GM's new mid-size fleet.

Model	1997	1998	1999	2000
Oldsmobile				
Achieva		Redesign due on new platform		
Cutlass	All-new small midsize sedan, new platform			

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Model	1997	1998	1999	2000
Intrigue	All-new midsize sedan; 240-hp supercharged 3.8L V6 engine option			
Eighty Eight/ LSS			All-new car on Aurora platform	
Aurora			Redesign due	
Silhouette	All-new minivan with 4th-door option			
Bravada				
Plymouth				
Neon		Minor trim, detail updates		
Breeze		Minor freshening		
Prowler	Limited-production aluminum hot-rod replicar debuts			
Voyager			Interim freshening	
Pontiac				
Sunfire			Interim facelift	
Grand Am		Redesign due on new platform		
Grand Prix	Major redesign on new platform			
Bonneville			All-new sedan on Aurora platform	
Firebird	Facelift; pop-up headlights disappear	Milder version of Corvette LS-1 V8		
Trans Sport	All-new minivan with 4th-door option			Interim freshening
Porsche				
Boxster		All-new mid-engined roadster due mid-year		
911		All-new replacement due; liquid-cooled flat-6 engine		Possible new 8-cyl. engine
Rolls-Royce				
Silver Dawn/ Silver Spur		Major redesign with BMW V8 engines		
Saab				
900		Styling, powertrain updates		
9000		New sedan, wagon debut mid-year		
Saturn				
SL Sedan/ Wagon				Major redesign due on new world platform

'97 Saturn Coupe gets a new exterior.

				2001
SC Coupe	Extensive exterior redesign follows sedan styling			Coupe redesign joins sedan on new platform
Innovate			Possible new Opel-based midsize sedan	
EV1	Saturn launches GM EV1 electric car		Switch from lead-acid to nickel-hydride batteries	

Model	1997	1998	1999	2000
Subaru				
Impreza	AWD Outback model debuts	Possible turbo engine		
Legacy			Facelift due	
SVX		Major redesign due		
Streega		First Subaru SUV expected		
Suzuki				
Swift		Interim facelift due		
Esteem			Interim updates expected	
X-90				
Sidekick		Dual airbags		

Pontiac's Trans Sport is steel, restyled for '97.

Toyota				
Tercel		Facelift due		
Corolla		Extensive updates due		
Camry	Major redesign set for fall intro			Interim freshening
Avalon		Major redesign due		
Paseo	Convertible joins lineup			
Celica			Styling, powertrain updates	
Supra			Trim, interior updates	
Previa		All-new front-drive minivan due mid-year		
RAV4	Optional engine upgrade planned	Electric RAV4 gets fleet tryout		
4Runner				
Land Cruiser				
Tacoma Pickup			3rd-door option	
T100 Pickup		V8 engine, U.S. production expected	3rd-door option	
Volkswagen				
Concept 1			Beetle-look subcompact debuts	
Golf		Major redesign (Golf IV) planned	New Cabrio; possible Corrado revival	
Jetta		Major redesign due		
Passat	Redesigned sedan, wagon debut			Interim updates
Eurovan				
Volvo				
850	Facelifted 850 debuts at Detroit show	AWD turbo wagon due mid-year		Redesign due on new platform
960			Front-drive replacement due	
C70		Sporty coupe, convertible planned for mid-year		

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***— The Washington Post,* June 4, 1996**

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Despite progress, American water supplies are erratically monitored and may contain contaminants with long-term health effects. Millions drink water that violates federal health guidelines.

Pesticides

Farmers used 1.25 billion pounds of pesticides and herbicides in 1995. Despite their earthy image, farmers usually side with chemical companies in anti-regulation lobbying.

Radon

Natural radiation appears in drinking water in isolated parts of the country. Arising from underground uranium deposits, it reaches water as radon, which can be inhaled during bathing.

Microorganisms

***Cryptosporidium* and other organisms like *cyclospora* and mycobacteria have evolved resistance to chlorine, the traditional treatment for disinfecting water.**

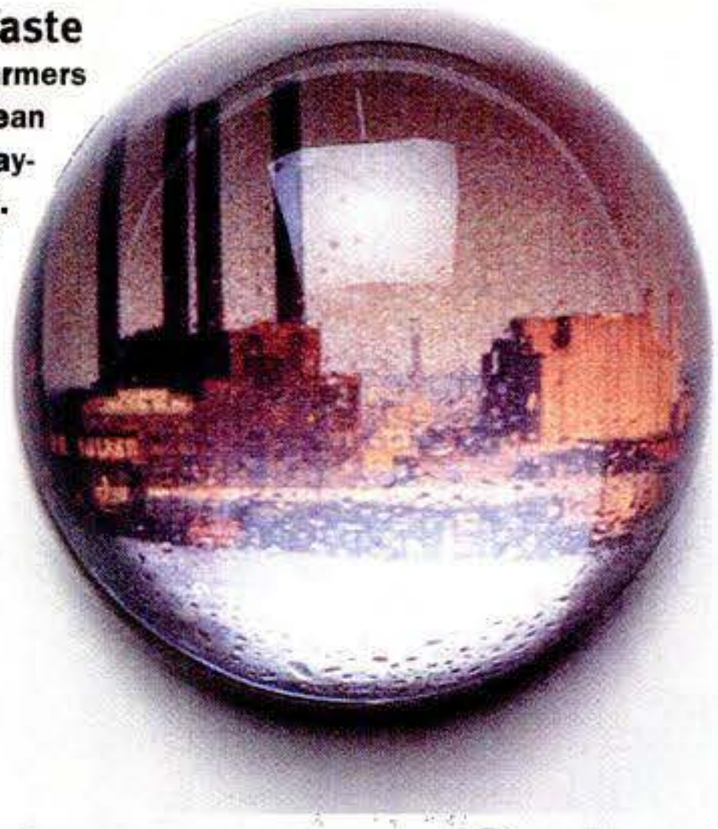
Chemicals

Industrial chemicals such as benzene, trichloroethylene, and gasoline additives can seep into water and cause diseases of the kidney, liver, and brain. Effects on reproductive organs are being studied.

Lead

Lead was known to be toxic in Roman times but is loosely regulated today. The replacement of municipal pipes will take decades, and many homes may never get new lead-free plumbing.

Industrial Waste
Factories and farmers do not pay to clean up wastes; taxpayers do. Most U.S. water treatment plants do not have technology to remove industrial or agricultural chemicals.



Don't take your drinking water for granted. Here's why you should get it tested and how.

By Mark D. Uehling

How Safe Is Your WATER?

ROBIN SMITH GOT UP HER NERVE. A housewife in Mechanicsburg, Virginia, she got her tap water tested—a step few Americans dare to take. Smith's envelope came back from the laboratory with bad news. "We don't drink our water," she says flatly. "Haven't for three years."

The amount of lead in her water, the lab reported, was more than double the level at which the U.S. Environmental Protection Agency advises people to take corrective measures.

Smith can't afford to replace the pipes in her home, and she realizes that swallowed lead could damage her brain cells and those of her two-year-old twins. So she hauls drinking water by car from the homes of her sister or her mother-in-law, who live nearby. Smith is just one of many Americans who are concerned about the quality of their drinking water. While officials repeatedly boast about the virtues of U.S. water supplies, the public is suspicious. Last year, Americans spent $2.1 billion on bottled water and $450 million on

PHOTO-ILLUSTRATION BY MARC TAUSS

Is Bottled Water Better?

THERE *ARE* SERENE SPRINGS and wells tapped by scrupulous companies that lovingly fill each bottle. But roughly one-quarter of all bottled water comes from the same rivers and lakes as municipal water. The massive quantities sold last year—2.43 billion gallons, or nine gallons for each American—make it unlikely that the stuff in your supermarket recently trickled out of the side of an alpine rock formation far from civilization.

So why bother? Because the best bottlers take additional steps to purify their product. "We don't want to scare anyone into drinking bottled water, but bottled water companies pick up where the EPA and the city treatment leave off," says Jennifer Levine of the International Bottled Water Association.

If tests confirm that your water is contaminated, bottled water can be a good solution. In a few isolated cases, however, government tests have found arsenic, bacteria, and industrial compounds in bottled water. So the only way to be sure that the bottled water you buy is superior to what comes out of your tap is to check the processing method.

Unfortunately, many terms used on bottle labels are not regulated by the FDA. "Pure," "natural," "organic," and "100%" are meaningless, and among the industry's favorite ploys. It would be perfectly legal to sell "glacier" water from a ditch in Gary, Indiana. "Those [words] don't have any meaning," admits Levine. "That's just marketing." Perhaps the biggest loophole is that water that is purified or distilled before bottling need not be labeled with its source. So your bottled water could be coming from the same place as your neighbor's tap water.

Even terms sanctioned by the FDA can seem silly. "Spring" water need not flow out of a spring; it just has to have the same composition as water that does so nearby. "Mineral" water refers to water with less than 250 parts per million of dissolved solids, not the stuff found under a rock in a pristine corner of Alaska.

A few regulated phrases are useful to buyers of bottled water. "Artesian" means well water from contained underground bodies of water, which are more protected from—but not completely immune to—agricultural runoff and industrial contaminants. "Purified" refers to water that has been treated in one of four ways: distilled by boiling, disinfected with ozone, filtered through absorbent carbon, or filtered through a membrane by reverse osmosis. Both purified and artesian water are free of lead.—*M.D.U.*

home treatment systems. At the heart of those two booming industries looms a question: Is my water safe?

Experts turn the question around, wondering if people who buy bottled water are easily frightened. "It's a lack of information, quite frankly," EPA Administrator Carol Browner told POPULAR SCIENCE. Which is not to say she has a rosy outlook: "I wouldn't take for granted the safety of this nation's drinking water. We still have very serious problems."

The truth about America's drinking water is simultaneously reassuring and disturbing. Our water has never been safer: Experts now worry about quantities of contaminants that could not be measured when the Clean Water Act was passed in 1972. Age-old scourges like cholera, dysentery, and polio—waterborne diseases still ravaging poor countries—are rare here. But new threats, threats specific to the late 20th century, are not being squarely faced by government at any level. "There is a huge segment of the population in the 20th century in America who can't go to their own taps," laments Brian Cohen, a water expert at the Washington-based Environmental Working Group. "We have not upgraded and invested in our drinking water treatment."

For roughly half of all Americans, tap water comes from lakes and rivers. For another 35 percent, it comes from underground aquifers. The remaining 15 percent of Americans rely on private wells, which are not regulated. But it hardly matters where you get your water, because any source can become tainted. **Even if you buy your water at the store, there's no guarantee that it's safe.** The biggest threats to the nation's water supply include three broad categories of contaminants, none of which are systematically removed by standard sand filtration and chlorine treatment:

- **Industrial and agricultural chemicals.** These have turned up in both well water and lakes. Known to interfere with hormonal systems in wild and laboratory animals, they may cause behavioral disorders, learning disabilities, and reproductive problems in humans.
- **Lead.** Used in plumbing, lead can cause brain damage even at low concentrations. Though lead pipes are no longer sold in the United States, lead is still allowed in new faucets because of lobbying by plumbing manufacturers. Lead monitoring programs are designed with budgets, not health, as the top priority.
- **Biological organisms.** Water treatment plants release 1.2 trillion gallons of raw sewage annually, much of which flows downstream to someone else's water supply. Organisms such as *Giardia* are growing resistant to chlorine disinfection, just as microbes infecting the body are becoming resistant to antibiotics.

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"You know how government is. You don't get all the results right away."

JOHN B. CARNETT

Harold and Mary Parentini of Columbus, New Jersey, have their water tested regularly and use a filter.

EPA figures show that in 1994, 45 million Americans, or about 17 percent of the nation's population, lived in communities that had violated water-related health standards at least once. In 1995, EPA data show, 69 million Americans lived in communities that exceeded the recommended levels for lead, and 12 million people were exposed to water that the EPA says should have been filtered but was not. Roughly 150,000 violations of the Safe Drinking Water Act occur annually, and few penalties are imposed for any of those except in high-profile cases.

And though you might assume someone is checking your water 24 hours a day, in actuality there are no requirements for daily, or even weekly, monitoring for chemicals, lead, or pesticides. Many contaminants are checked once every four years, if at all. Waivers and exemptions to pollution-monitoring requirements are granted readily and legally. Loopholes make it easy for uncertified, untrained water "engineers," especially at smaller utilities, to hide problems. Drawing samples is on the honor system. And there is no single national mandate for water monitoring; each state adopts its own approach. "It's not a national issue," says Carl Reeverts, head of the data branch for the EPA's water programs. "It's a local issue in terms of what your local water system provides."

So how do you know what's in your water? By law, you can ask local water officials, but they may not be willing or able to discuss the subject in plain English. At the 1996 convention of the American Water Works Association, a trade association for water managers, one attendee suggested stating even the most alarming results in ways that make them seem insignificant. "If you put a lot of zeros to the right of the decimal point, people don't react, even if it's a really high number," he said, noting .0003 milligrams per liter sounds better than 3 parts per billion, a dangerous level for some contaminants.

That kind of talk can make people like Harold Parentini blanch. He got his water, and that of his retirement community, tested after realizing he lives near a garbage dump that doubles as a toxic waste site in Columbus, New Jersey. "You know how government is," the 77-year-old retired pharmacist says with cheerful cynicism. "You don't get all the results right away." So Parentini regularly sends samples away for independent testing. The results indicate that his water is fine, but Parentini is taking no chances: He has installed a filter. [For more on water filters, see "Filters and Other Home Remedies."]

Even when water meets government standards, it may not be safe for everyone to drink. Last year, in a surprising admission of failure, the EPA and the Centers for Disease Control issued a little-publicized directive advising people with severely compromised immune systems to consider boiling their water. The directive, which applies not only to AIDS patients but also to some of the elderly and many cancer patients, could affect 10 percent of the U.S. population, or about 25 million people.

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JOHN B. CARNETT

After their trees died, Walter and Connie Stachelek of North Wales, Pennsylvania, had their water tested.

"We developed a problem with bacteria. But we were glad that nothing turned up that was more serious."

"The number could be quite high," agrees Edward F. Rossomando, director of the Waterborne Disease Center at the University of Connecticut Health Center. The main risk is a protozoan, *Cryptosporidium parvum*, which forms cysts that can cause severe intestinal problems. The cysts have evolved to withstand harsh environments and can easily survive a dunking in Clorox, which is far stronger than the chlorine in most water treatment systems.

According to *The New England Journal of Medicine*, as few as 30 cysts can cause diarrhea in a healthy person and can be fatal to an AIDS patient. In a 1993 outbreak, *Cryptosporidium* killed 100 people in Milwaukee. The water systems of America have no credible defense against this parasite. "The level of technology is back in Louis Pasteur's time," says Rossomando.

The EPA does not require that engineers check for *Cryptosporidium*, citing the cost and technical difficulty of identifying the parasite. As a result, future outbreaks are likely. "Surface water should be continuously monitored for *Cryptosporidium*," says Thaddeus Gracyzk, a microbiologist at Johns Hopkins University. "It should have been started a long time ago."

Other waterborne perils take much longer to cause harm. Chlorine byproducts called trihalomethanes, of which chloroform is the best-known example, take years to cause an estimated 10,000 cases of bladder and colon cancer annually. That's ironic because chlorine generally makes water safer. "If you pour yourself a glass of water and it smells like bleach, you might think of not drinking it," suggests Dr. Robert Morris, an expert on trihalo-

Yes, you should get your water tested. For more information, including answers to frequently asked questions, and a personalized checklist of concerns, visit the POPULAR SCIENCE home page at *www.popsci.com*.

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methanes who works as an epidemiologist and family practice physician at the Wisconsin College of Medicine. "We've been too reliant on chlorine as a solution."

Unfortunately, though, some water systems follow the example of Washington, D.C., adding *more* chlorine when bacteria counts rise. In a few states, it's gotten to the point where officials routinely check for cheating on water samples. One analyst in Pennsylvania, Richard Stump, says some samples he processes reek of chlorine—evidence of tampering to produce good results. "We just reject those," says Stump, laboratory director for Suburban Water Testing Laboratories. "Ethically, I cannot process a sample like that."

Stump *could* handle a sample from someone like Janet Tapper of Portland, Oregon. Local authorities did not answer all her questions about water quality after they switched her home to a new water supply—the Tualatin River, which carries farm runoff. "They said they knew there were certain levels of pesticides in there and that they were coming from farmland," she recalls. Uncertain about what might be entering their water supply, Tapper and her husband spent several hundred dollars to install a Multi-Pure filter. "We felt we'd be better safe than sorry," she says. But even Tapper, knowledgeable as she is, did not take a basic step: getting her water tested.

Most experts recommend testing as the first line of defense, especially for common but dangerous contaminants such as lead. Richard Maas, director of the Environmental Quality Institute at the University of North Carolina in Asheville, heads a team that has analyzed water samples from 100,000 American homes. "You've got a one-in-six chance that you are being exposed to neurologically damaging levels of lead in your tap water," warns Maas, who says some researchers believe deficits in intelligence can be correlated with lead levels. "It's about one IQ point, we think for [each] ten parts per billion of lead," says Maas.

Surprisingly, when it comes to lead and many other compounds, the EPA does not have firm rules. Today's patchwork of water laws and regulations includes so many exceptions, exemptions, and loopholes that engineers simply do what their great-grandfathers did: chlorinate. It's all they know. "We've been stagnant for 80 years," says Erik Olson of the Natural Resources Defense Council, a leading voice for clean water. "We have not made any improvements since chlorine and filtration were introduced in the early part of the century."

Politicians back up their engineers. My town, a mayor pleads, can't afford water *that* clean. Such complaints are not likely to disappear even though Congress recently passed legislation to revise the Safe Drinking Water Act.

How to Test the Waters

YOU LIVE IN A CABIN 50 miles from the nearest highway. You have one neighbor—an Amish widow. Should you get your water tested? Yes.

Norman Rockwell's America is dead. Today, even well water can become contaminated—by septic systems or agricultural chemicals, for example. And in urban areas served by the most advanced water treatment systems, thousands of people can still get sick from drinking tap water.

Most industrial and agricultural threats cannot be tasted or smelled, so it makes sense to have your water professionally tested, especially if you have children in your household. Their undeveloped blood-brain barriers make them particularly vulnerable to lead. Also, the stomachs of toddlers less than four months old absorb nitrates (from fertilizers) that can cause methemoglobinemia, or blue-baby syndrome.

The good news is that once a test is complete and, as is most likely, shows no problem, there is no need to buy bottled water or install a filter. Researchers agree it is wiser to confirm your water is safe than to buy truckloads of Evian on the basis of suspicion. It's cheaper too.

People who have had their water tested speak with relief: They know what's in their water, and take appropriate preventive measures. "We developed a problem with bacteria," concedes Walter Stachelek of North Wales, Pennsylvania, who became worried about his well water when five huge oak trees in his yard died suddenly. "But we were glad that nothing turned up that was more serious." Only a few percent of water samples sent to independent testing labs show serious contamination.

If you do discover problems, have your water retested after taking corrective measures. And if you live in an area that experiences seasonal fluxes in contaminants—from farm runoff, for example—you should draw samples when contaminants are likely to be at peak levels.

To find a lab certified by your state, check the Yellow Pages or the EPA's drinking water hotline at 800-426-4791. To arrange a $17 test for lead in your water, call the Environmental Quality Institute at 704-251-6800. Suburban Water Testing, at 800-433-6595, offers a wide range of home water tests from $50 to $475. National Testing Laboratories, at 800-458-3330, the nation's largest testing firm, offers a screen of basic contaminants for $94. For more information about drinking water, including answers to frequently asked questions, and a personalized checklist of concerns, visit the POPULAR SCIENCE home page at *www.popsci.com*.—*M.D.U.*

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Filters and Other Home Remedies

THE TRICKS OF DISREPUTABLE marketers of water filters are limited only by the imagination. One bogus operator sold a copper apparatus that provided no treatment whatsoever but that did come with a rabbit's foot or a copy of the New Testament. Regulators uncovered the scheme and forced him to refund the money. "A number of people didn't want their money back," recalls Ellen Crocker, a U.S. General Accounting Office auditor. "They said it worked just fine."

Even though there is virtually no federal regulation of the filter industry, reliable products do exist. "The critical thing is knowing what your problem is, and what the technology will do," says Joe Harrison, research director of the Water Quality Association, which accredits technicians and contractors. A consumer information package is available from the association at 800-749-0234.

There are three major technologies for water treatment in the home, and little agreement on which is best for a particular pollutant. It's a good idea to seek advice from a professional plumbing contractor before you install a system. Carbon-based units in "granular" or "solid block" configurations can trap chlorine, lead, and petroleum compounds. Reverse osmosis uses a semipermeable membrane that can remove a wide variety of minerals and large manmade molecules. Distillation is boiling, which removes some manmade contaminants. In general, the cheapest pitcher/filters cost $20; the most expensive basement systems cost $1,000.

NSF International, a nonprofit trade organization, evaluates filters to see how they measure up to manufacturers' claims. To get a booklet of products that make the grade, call 800-673-6275. Products meeting NSF standards #53 or #58 are the only ones likely to solve bona fide health problems. Respected names include Amway, Brita, Culligan, Everpure, Kinetico, and Pur.

Even NSF certification is no guarantee of long-term reliability. Thanks to complex plumbing, some home treatment systems are prone to clog or break. Other models may work with agonizing slowness, dribbling out a gallon in seven hours. Some systems can't tolerate hot water or are fouled by hard or iron-rich water.

A poorly maintained filter could be worse for your health than drinking tap water. So it's important to follow manufacturer's instructions carefully, or to purchase a maintenance contract from an installer. If you perform the maintenance yourself, you may want to test your water regularly to make sure your filter is working.—*M.D.U.*

The new law requires utilities to alert newspapers and TV stations to what's in the local water. Meanwhile, federal officials say states are in charge. State officials say Washington has not provided the necessary funds for overseeing the water supply. Blame, like water evaporating and falling back to earth, cycles between different levels of government.

Officials at the local level, of course, are the most vulnerable to citizens' wrath. Some of that blame is misplaced, because local officials have little control over contaminants entering their watersheds from thousands of sources, many of them located in rural areas. In July, the CDC reported that four Indiana women had had miscarriages, some more than once, because of high levels of fertilizer compounds in their drinking water. The chemicals had reached the women's wells. The women no doubt assumed well water would be insulated from whatever is happening to the rest of the country. Yet all water systems are connected by modern life, which spreads thousands of barely understood chemicals across the landscape and into once-impregnable corners of the American heartland.

Which leads us to the Rev. George Ogle. A resident of rural Illinois, he became an activist after learning of the pesticides leaching into his water supply. He and his wife have gone on and off bottled water; the stuff that comes out of their kitchen tap has levels above federal guidelines for atrazine and cyanazine, two toxic weed killers popular among Midwestern farmers. (Even those guidelines are three to 10 times higher than what is allowed in food.) "At least two-thirds of my life, no one thought about the water," says Ogle. "Nowadays, it's one of the major day-to-day worries." Some Illinois towns, including Danville and Decatur, supply bottled water to residents when pesticide or nitrate levels in city tap water get too high. "Unfortunately," says Ogle, "our society doesn't value itself enough to improve the water supply."

Like the Ogles, many Americans are worried about the quality of their drinking water. But that concern isn't always shared by the people in charge of water systems, says John Cameron, associate director of Citizen Action in Chicago. "These are not public health experts," he says. "They are not experts on oncology. They're water engineers." And at the federal level? "The EPA has been diddling around for some time," he scoffs. "I think we can provide clean drinking water without having every American be their own water utility." Perhaps the biggest irony of all is that much cleaner drinking water might be had for just $30 per person, according to the EPA. That's a drop in the bucket compared to what worried citizens already spend to bring water home from the grocery store. ◆

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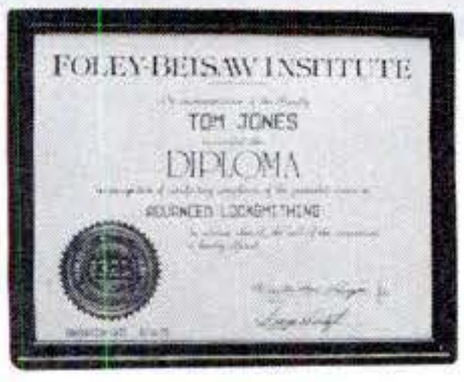

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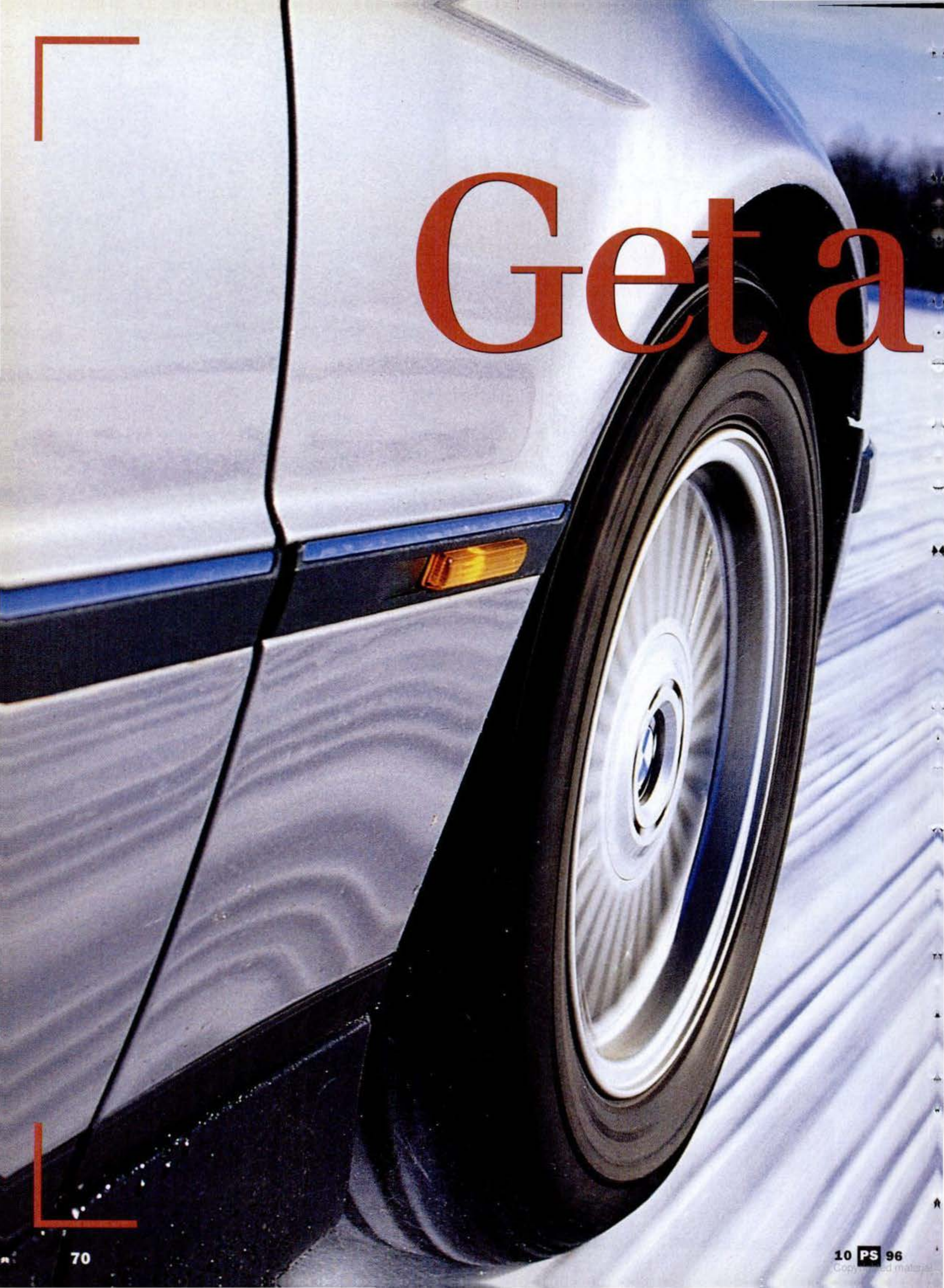

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Grip

Advanced stability systems tackle winter's worst.

WE'RE CREEPING DUE SOUTH somewhere on Michigan's Upper Peninsula when darkness and a mean blizzard tighten their grip on our test fleet: a Cadillac Seville, a Mercedes-Benz S420, and a BMW 750iL. Lit by headlamps, the blowing snow fills our windshields with blurry white dots eerily reminiscent of the shift to hyperspeed in *Star Wars*. Contrary to that illusion, speed is the last thing on our minds. When Upper Michigan's winter weather gets this bad, survival is the priority. Staying on the road demands our full concentration.

Luckily, advanced technology is on our side. Since this is the return journey from our annual winter test, and this year's subject of investigation is electronic stability systems, we know precisely what the latest and greatest car handling aids can and cannot do. The new systems use advanced electronics to actively intervene in one of the worst winter-driving situations—a skid that threatens to put your car off the road. The technology actually activates a brake on a single wheel—something beyond the bounds of normal driver control.

By Don Sherman

We had our first chance to look at this technology early in 1995, at which time the systems were headed toward the U.S. market [see "The Spin Doctors," Dec. '95]. Now we were ready for a more exhaustive test. When the combination of cold, snowy weather and the arrival of test vehicles fell into proper alignment, we scheduled a few weeks of subjective evaluation and several days of objective testing at two proving grounds to quantify how well these systems work.

Stability systems are the next logical step in a process that began with antilock braking in the early 1980s. Then came traction control, beginning with a few 1989 models. BMW was the first to introduce a handling-enhancement system called Dynamic Stability Control (DSC) in the 1995 model year as standard or optional

PHOTOGRAPHED BY JOHN B. CARNETT

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Cadillac's Integrated Chassis Control System activates front brakes only because of the car's inherent stability advantages.

equipment for its 7- and 8-series cars. Mercedes-Benz fielded its Electronic Stability Program (ESP) for 1996 S-class and SL-class models powered by a V8 or V12 engine. Last winter, Cadillac introduced its version, called Integrated Chassis Control System (ICCS), with stability enhancement. It is standard equipment on 1997 Cadillac Seville Touring Sedan, Concours, and Eldorado Touring Coupe models.

Since ICCS production had not yet begun at the time of our test, we borrowed a Seville engineering prototype from Cadillac for evaluations. The BMW 750iL and the Mercedes S420 are current production models.

Activating the DSC system brought a significant gain in stability, but speed averages dropped.

We were well-aware that these three systems differed greatly in scope and design. One reason is market timing —every maker's desire to be the first out with a new feature, even though that particular technology is rapidly evolving and improving. The second reason is major chassis differences—both the BMW and the Mercedes-Benz are rear-drive designs, while every Cadillac that would benefit from ICCS is a front-driver. The location of tractive (propulsion) forces is one of the key issues related to directional stability.

Even though BMW deserves credit for being the first out, its system must be considered an interim design. (A far more sophisticated approach is under development for introduction on 1998 BMW 3-series models.) The DSC equipment list is short: four wheel-speed sensors and a steering-wheel position sensor. These transducers communicate with microprocessors that manage traction control, antilock braking, and engine braking (during lift-throttle deceleration) functions. In turn, the computers modulate brake pressure to prevent wheel lock, adjust ignition timing and throttle position to avoid wheel spin, apply the rear brakes as needed to aid traction control, and open the throttle in certain instances to curtail lift-throttle oversteer. DSC is, in essence, a straightforward extension of already existing functions.

The BMW's sensor array helps the control computer know when to take corrective action. The underlying theory is the fundamental relationship between front-wheel speeds and steering-wheel angle. It's as simple as this: Crank the steering wheel to the right, and the left front wheel turns more quickly than the right front wheel as the car corners through an arc. When wheel speed and steering position go out of kilter, the control computer senses a stability problem. If the front-wheel speed differential is too small, the car is understeering (the front slides wide of the desired arc). If the speed differential is too large, it's oversteering (the tail drifts wide of the intended arc).

Two types of corrective action follow concurrently. Drive torque is reduced and the rear brakes are selectively applied to slow a wheel that's beginning to spin. This restores lateral grip at the rear of the car and helps the driver regain directional control.

Though essentially similar, the Mercedes-Benz approach has some important differences. Instead of sensing the loss of stability indirectly by comparing front-wheel speeds to steering-wheel position, ESP makes that determination directly with a yaw-rate sensor.

The second difference is that Mercedes uses all four wheels, one or two at a time, to generate a yaw torque (twisting action) about the car's vertical axis. Imagine, if you will, a model car with a toothpick inserted vertically through its center of gravity. That toothpick is the yaw axis; in an oversteering condition, the car spins about this axis. If an opposing yaw torque is created by braking one wheel, it can neutralize the spin. Braking the left rear wheel helps stabilize a spin to the right, and vice versa.

ESP also diminishes understeer by increasing the yaw rate, in effect helping the car turn the corner. And in the event braking just one wheel is insufficient to get the car back on track, ESP has the authority to brake the second wheel on the same side of the car to augment yaw torque.

Cadillac's ICCS falls somewhere in the middle. Like the Mercedes system, it uses a yaw-rate sensor to signal an impending loss of directional stability. The appropriate yaw-torque correction is then created by a brake application at just one wheel. Like the BMW, the Cadillac system operates by applying brakes only on the drive wheels, in this case, at the front of the car.

The beauty of all three types of stability-enhancement gear is that practically nothing is required of the driver. Except for the flicker of a warning lamp or alphanumeric display and an occasional thump under the hood, these systems work as unobtrusively as a deft butler. You do the steering, and these computer-aided chassis systems take care of everything else to keep you on the straight and narrow.

To put these systems to the test, we visited two proving grounds and logged plenty of over-the-road winter miles. The venue that beckoned us to the northern fringes of Michigan was a winter test site operated by ITT Automotive that offered a wealth of groomed surfaces. To examine dynamic performance on dry pavement, we waited for a sunny day to visit Milan Dragway

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Cadillac Seville STS

HANDLING			
Slippery surface, stability system off/on:			
600-foot slalom (mph)	26.8/25.8	28.6/28.1	28.9/29.0
Double-lane change (mph)	32.0/33.8	31.3/31.1	32.2/31.9
1-mile circle (mph)	58.4/56.8	60.3/54.7	57.7/54.4
Dry surface, stability system off/on:			
600-foot slalom (mph)	47.4/47.1	47.7/48.1	47.1/45.4
Double-lane change (mph)	57.0/58.6	55.2/56.3	55.5/56.3
POWERTRAIN			
Engine	SOHC 5.4L V12	DOHC 4.6L V8	DOHC 4.2L V8
Valves/cylinder	2	4	4
Power (hp @ rpm)	322 @ 5,000	300 @ 6,000	275 @ 5,700
Torque (lb-ft @ rpm)	361 @ 3,900	295 @ 4,400	295 @ 3,900
Transmission	5-speed automatic	4-speed automatic	5-speed automatic
CHASSIS			
Front suspension	Strut-type, coil springs	Strut-type, coil springs	control arms, coil springs
Rear suspension	Multilink, coil springs	Control arms, coil springs	multilink, coil springs
Brakes, f/r	Vented disc/disc	Vented disc/disc	vented disc/disc
ABS	4-channel	4-channel	4-channel
DIMENSIONS			
Wheelbase (in.)	120.9	111.0	123.6
Length (in.)	201.7	204.1	205.2
Width (in.)	73.3	74.2	74.3
Height (in.)	56.1	54.5	58.5
Curb weight (lbs)	4496	3869	4650
PRICES			
Base price	$90,930	$48,135	$74,495
Price as tested	$92,630	Not available	$79,145
Major options	Gas-guzzler tax, $1,700	Not available	ESP, $1,870; CD changer, $885; heated front seats, $595

BMW 750 iL

Mercedes-Benz S420

at the opposite end of the state.

Procedures were, for the most part, consistent with our normal car and truck comparison tests. To gauge maneuverability, we used a 600-foot slalom course. To assess each car's stability during an aggressive accident-avoidance exercise, we used another cone course that forced the driver to dart smartly left, and then right, to clear an imaginary object in the road. Each test was conducted on a slippery snow-packed surface and on dry pavement. To study stability at highway speeds, we added a third type of test—laps against the stop watch around ITT's slippery one-mile circular track. And to gauge the effectiveness of each stability system in the aforementioned situations, we used the simplest of all expedients: the on-off switch.

First up was the 750iL, BMW's largest and most luxurious model, with a price tag equivalent to a comfortable home in the suburbs ($92,630). Weighing well over two tons and loaded with 322 horsepower, its natural stride is high-speed, straight-line cruising, not zigzagging around pylons on a frozen surface.

In the slalom course, this car executed several double axels (spinouts) when the rise of momentum from repeated left and right turning finally exceeded available traction. No sig-

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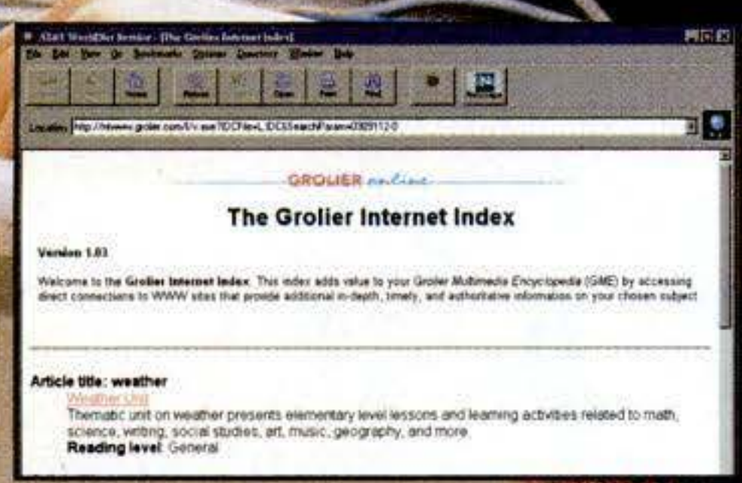

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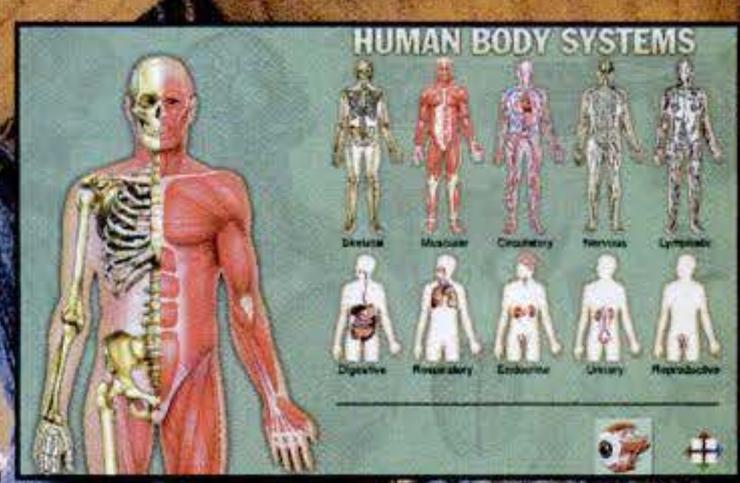

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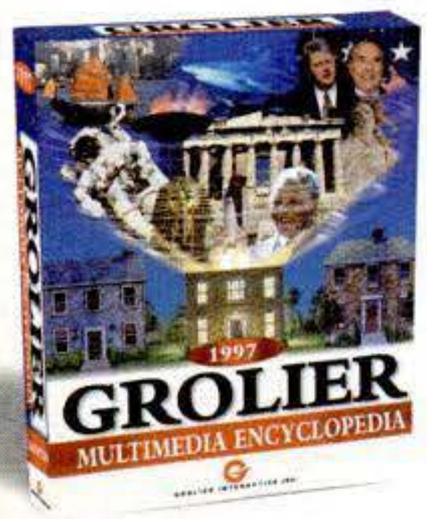

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Mercedes' ESP operates aggressively on all four wheels to make this luxury sedan practically spin-proof.

nificant gain in stability occurred with the DSC system active, but there was a definite loss of average speed through the course.

Exactly the opposite occurred in the double-lane change event: both speed and stability were improved with DSC. On the one-mile circle, where the average velocity was twice as high (60 versus 30 mph), keeping the tail from wagging the dog was literally a handful for the driver. For more than a minute, the steering wheel was a blur of large-amplitude corrections. Even with the throttle buried deeper, the speed around the course was lower with DSC energized and active.

Any doubts about the worth of this system were erased during dry-pavement testing, where its positive effects were much more evident. With DSC off, the 750iL was unstable and wobble-prone when pushed to the limit in the slalom. Keying it back on eliminated nervous gyrations at the rear of the car. The same was true in the double-lane change, where the BMW gained both stability and speed.

The key limitation with DSC is that it can't generate corrective yaw torques. One-wheel braking is used only to stop a rear wheel on the verge of spinning. In this sense, DSC is really just a more sophisticated form of traction control. If the driver's foot is off the accelerator, DSC does nothing to enhance cornering stability.

Cadillac takes a much different approach. Even though the Cadillac system also works only on the drive wheels, it does have the authority to engage the brakes to enhance stability. But Cadillac engineers tuned their system to be as unobtrusive as possible so that it doesn't barge in and seize control of the car from the driver. Implementation of a simple two-channel system (front brakes only) is justified by the inherent stability advantages of a front-drive sedan. Since the front tires generate 100 percent of the propulsion force and carry more than half of the car's mass, there's a very low likelihood of the rear tires losing their grip first during an aggressive maneuver. In other words, when loss of control in a Cadillac Seville occurs, you'll invariably be in the understeer mode (the nose slides wide).

In our slippery slalom, the Seville demonstrated its understeering tendencies, true to the theory above. With its stability system energized, there was more understeer than with it off. Average speed fell a bit with ICCS on. The same was true in the double-lane change, although the driver acknowledged that ICCS was a definite aid to executing the course without also executing a pylon. On dry pavement, the Seville was clearly helped by its stability system. Speeds and the test driver's thumb both went up. The Cadillac was tidier and more predictable in its moves and much easier to wriggle through the tightly spaced cones.

On the big slippery circle, the Cadillac Seville was by far the most difficult of the three sedans to handle, due to a surprising tendency to hang its tail wide while cornering at the adhesion limit. That was still true with the stability system active, although the average speed dropped significantly.

The Seville system deserves a bang-for-the-buck award because it is quite effective while adding little to manufacturing costs and nothing to the retail price. That said, we hope engineers are busy with the four-wheel version to make ICCS even more effective in the customer's hands. By adding the capability of rear-brake actuation, ICCS can be tuned to more effectively manage the ill effects of understeer.

Our golden snowball award goes to the Mercedes-Benz S420 for bringing a remarkably adroit stability-enhancement system to this winter test. As the tabular results show, its effectiveness is not revealed by higher speeds. To the contrary, you can feel ESP slowing down the car to boost its stability. This is a built-in side benefit, because it often uses braking at two wheels—one in front, one in back—to generate the desired yaw corrections necessary to maintain stability. Slowing the car also boosts the driver's confidence and ability to regain control of a marginal situation.

In contrast to the Cadillac approach, ESP seizes command of the situation early and decisively to envelop the car in a protective safety net. It can't be fooled: ESP never allows the tail to drift wide. This was quite evident on ITT's frozen circle, where the driver selected an arc with the steering wheel, locked the throttle flat on the floor, and circulated around the track with ESP fully in charge of the necessary course corrections. Absolutely no sawing at the wheel was required.

The real beauty of Mercedes' ESP is that it conjures up corrective actions that no driver—not even a highly skilled one—can match. Activating one or two brakes at precisely the right instant to maintain stability and restore control is the next best thing to having God as your copilot.

ESP is one safety breakthrough that all cars should have, and the sooner the better. ◆

BMW's DSC aids stability through traction control, but it lacks the authority to activate brakes after the throttle is released.

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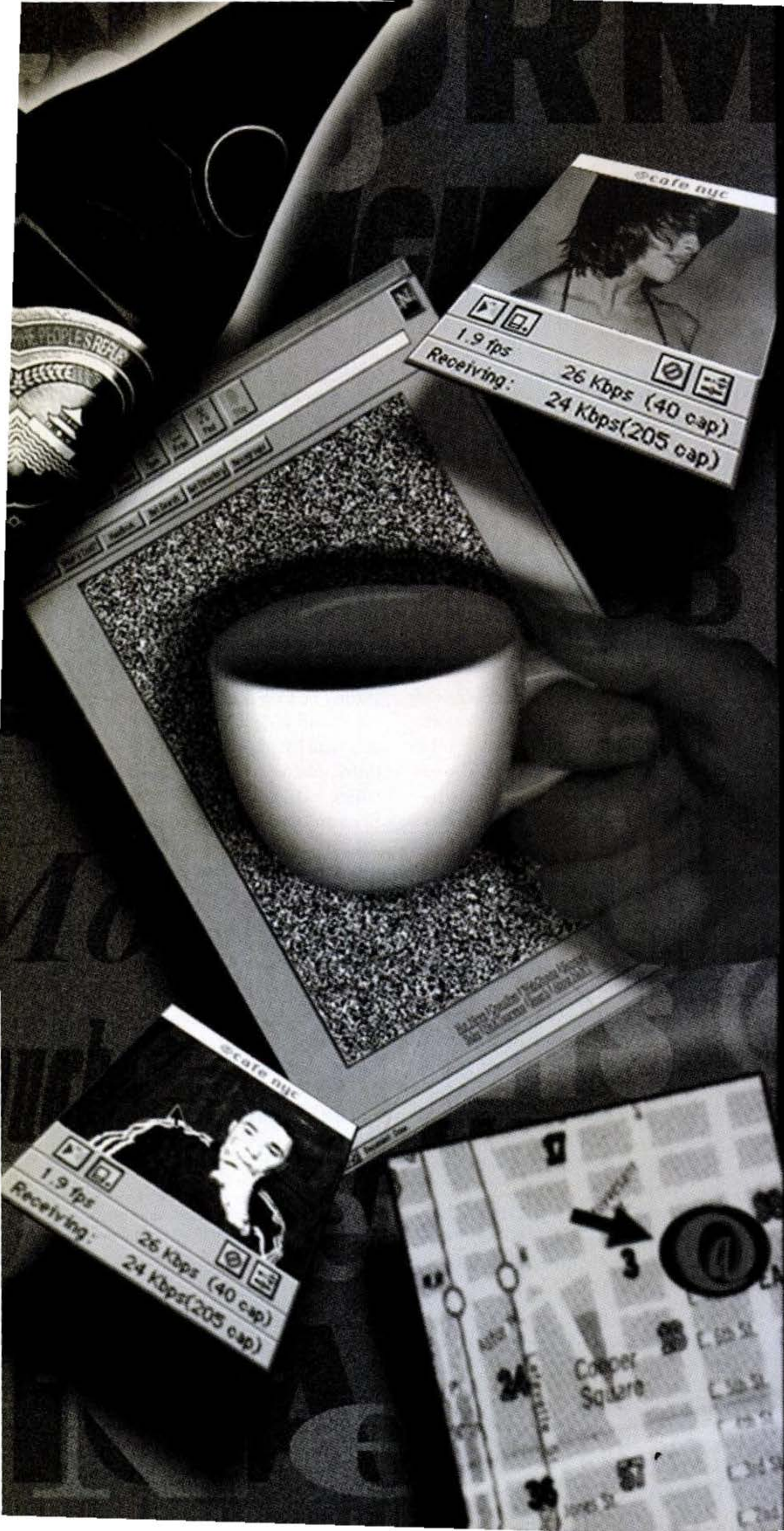

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A SPECIAL ADVERTISING SECTION

Fall Home Remodeling Ideas

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Fall

HOME REMODELING IDEAS

For many homeowners, particularly those of us who live in areas with seasonal climate changes, autumn is a time to "move back" into our homes after a summer of outdoor activity. Bicycles and barbecues are cleaned and readied for winter storage, painted lawn and deck furniture is touched-up to prevent rust through the winter, and the grass is cut one last time before the mower joins these and other articles in the garage loft, attic or basement.

Being indoors more also inevitably results in a reassessment of one's living area, as you reacquaint yourself with needed interior repairs or projects that were left planned but uncompleted in those first warm days of spring. Fall is also a good time to begin indoor home-improvement projects for another reason: The approaching holidays usually mean family gatherings, guests and entertaining, and you want your home to look its best and function at its most efficient.

No matter what type of work you tackle, it's always better to start with quality tools and materials. Smart homeowners build their tool collections over the years—adding new tools as they're needed for one project or another, replacing the ones used most as they wear out, or upgrading to more capable tools as your own skills increase. A well-made and well-cared for tool will often last a lifetime, and some tools become functioning heirlooms that are handed down from generation to generation. If you're smart enough to keep your tools carefully organized and in good working condition, it pays to buy the best quality you can afford.

Hammers, the most basic of all hand tools, are a prime example. Although it seems impossible, even hammers wear out. The striking face can lose its temper and soften or chip, the bond between the head and handle can loosen, and the handle itself can break. Whether any of these problems ever

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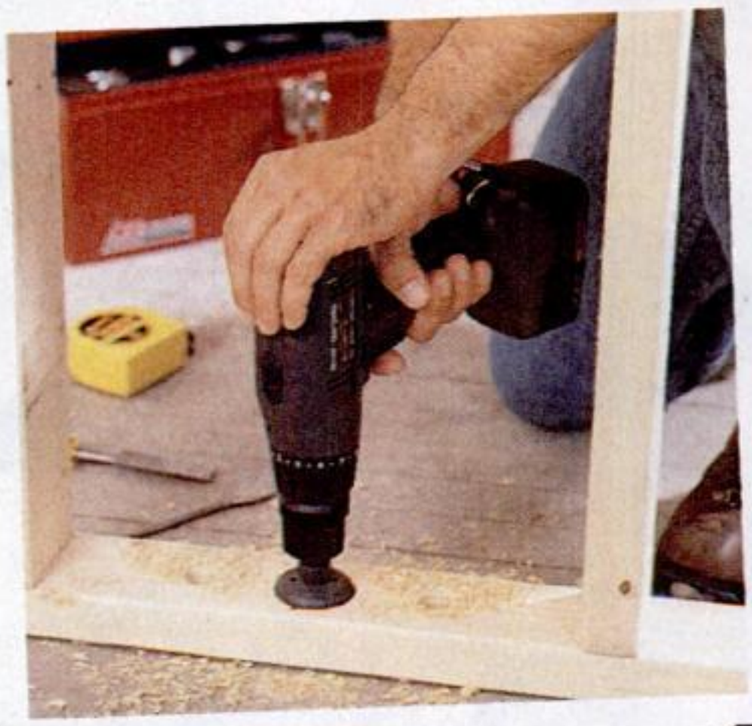
With home remodeling, you have lots of options: Do all of the work yourself, hire a contractor to take care of the whole job, or work with local tradesmen and take on as much of the job as you can adequately handle.



Some of the basic steps are easy, requiring a little knowledge of construction and the right tools. This Stanley fiberglass-jacketed hammer, along with a powerful and versatile Sears Craftsman 14.4-volt cordless drill/driver (inset), make for quick, accurate work.

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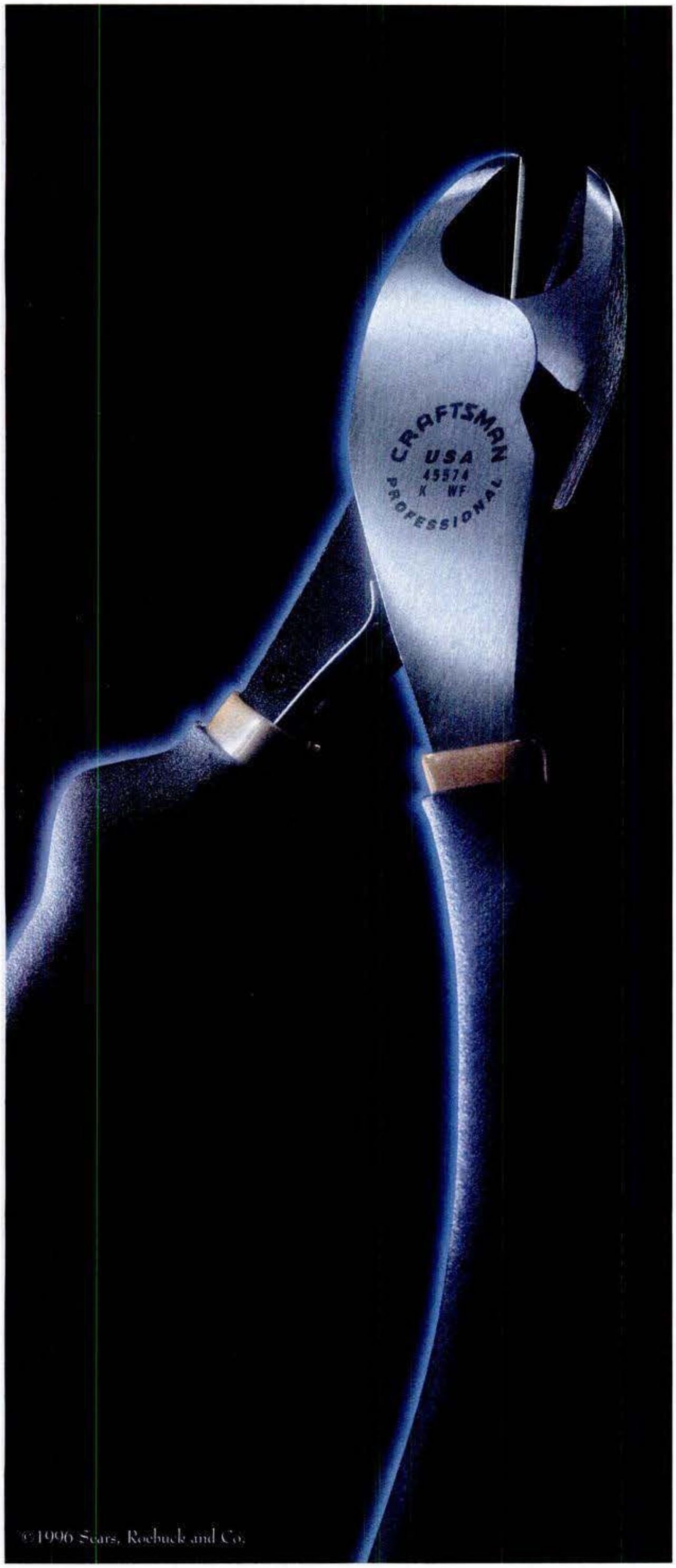
ALONG WITH THEIR TUNGSTEN CARBIDE BLADES, SPRING-LOADED HANDLE AND CUSHIONED HAND GRIPS, THESE BABIES EVEN LOOK SHARP.



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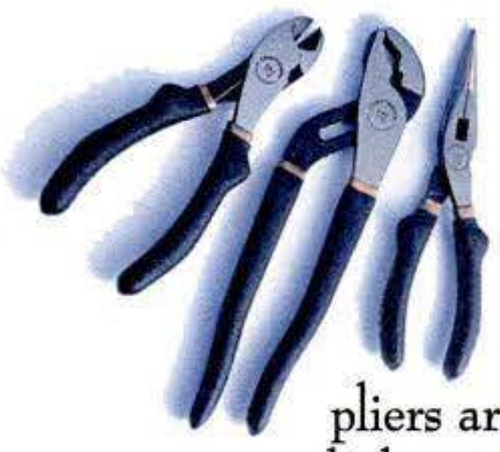
Just hold them in your hand and you can feel their power. That's what the new Craftsman Pro Series line of pliers is all about. Sure, they look great, but what really sets them apart is that they're loaded with tons of unique features. Features like Tungsten Carbide impregnated cutting blades that stay sharper 50% longer, and cushioned hand grips so you'll last longer too. Plus, the 7-inch wide-jaw diagonal cutters feature exclusive on-demand spring-loaded handles to snap back into working position so they're ready to go whenever you are.



And right now these revolutionary pliers are available in a 3-piece set including 7-inch wide-jaw diagonal cutters, 9 1/2-inch arc-joint and 8-inch long-nose pliers, for only 39.99*, a 60 dollar value if purchased separately.

Plus, like over 2,200 other Craftsman hand tools, the Pro Series are all made in America and guaranteed forever. Just come in to any Sears or Sears Hardware Store, or simply pick up the phone and call us at **1-800-377-7414** today to order your set of Craftsman Pro Series pliers. And, be sure to ask for your free Power and Hand Tool Catalog (offer code #801343) including the latest Craftsman innovations. After all, what good is looking the part if you can't back it up?

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Fall
HOME REMODELING IDEAS

occur, however, is determined by the difference in quality between one hammer and another. Poor quality hammers not only wear quickly at the stress points mentioned above, but they can be dangerous to the user. The very best hammers are built to take a pounding as well as give it. The Stanley fiberglass jacketed hammer we're using, for example, is made with high-carbon steel and has a reinforced contour-grip handle and permanently bonded head-to-handle joint. Look for qualities such as these—for safety as well as value—when you shop for your next hammer.

The advent of electronics has made big changes in our lives, even though we don't often notice it—that is, if and when we notice it at all. This is especially true in and around the home. "Set it and forget it" appliances, multitask controls, and maintenance-free products with longer warranties are now the norm from kitchen to garage. And nowhere is this more evident than in cordless products, especially cordless tools. By now, just about everyone has owned at least one of them and can understand why they are so popular: No electrical cords to tie you down, no need to always have an outlet nearby, and no hassle.

But if you're still using a cordless tool that's five or more years old, you're missing the best part: More power. Today's battery-powered tools really deliver in terms of pure muscle, or torque, higher rpms for speed and efficiency, and longer run-time between rechargings. The Sears Craftsman 14.4-volt cordless drill/driver we're using sets a new standard in hand-held battery tools. It has a power pack that not only runs stronger and longer, it's also smaller and lighter than the last generation of less-capable batteries. That means more work with less fatigue for the user. And because this drill/driver has the power to perform virtually all of the tasks that corded tools can do,

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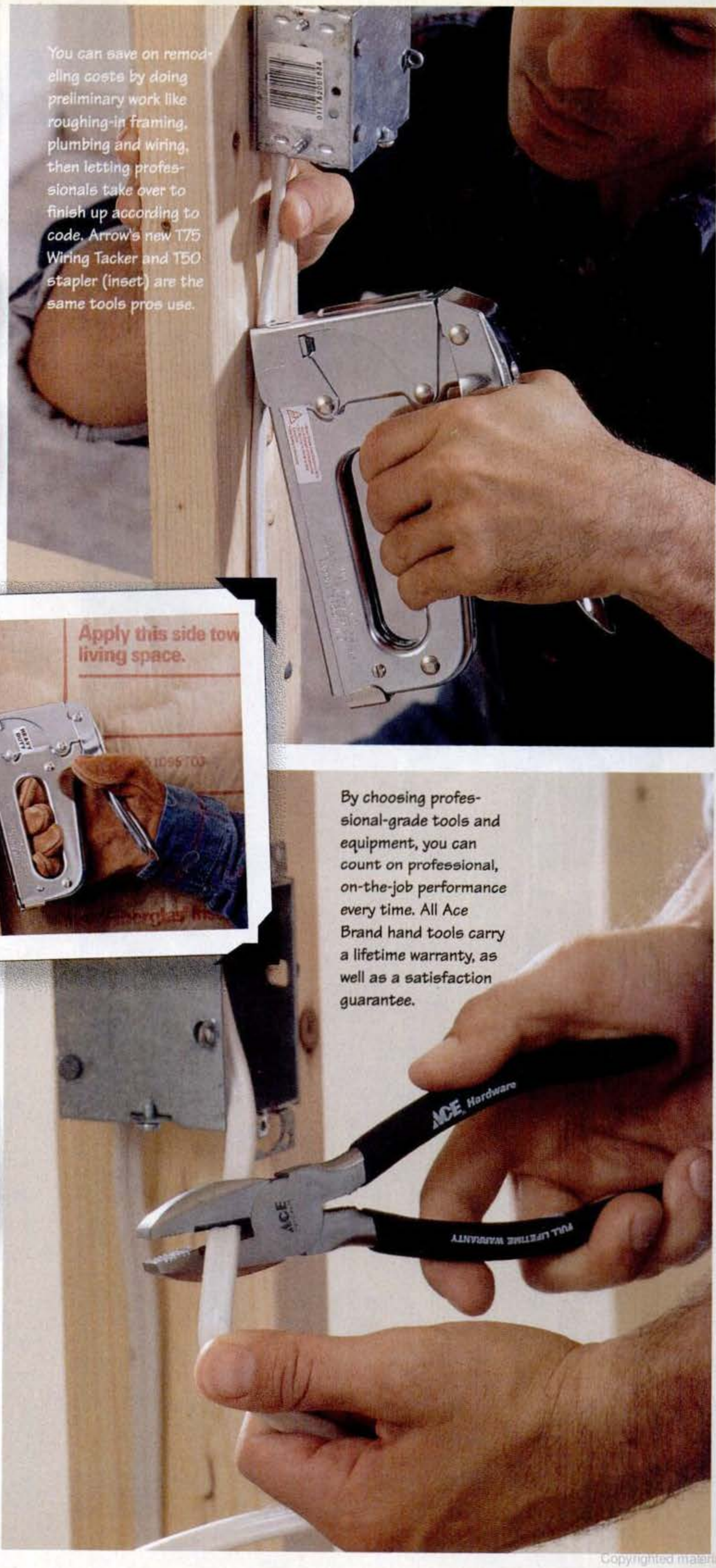

You can save on remodeling costs by doing preliminary work like roughing-in framing, plumbing and wiring, then letting professionals take over to finish up according to code. Arrow's new T75 Wiring Tacker and T50 stapler (inset) are the same tools pros use.

By choosing professional-grade tools and equipment, you can count on professional, on-the-job performance every time. All Ace Brand hand tools carry a lifetime warranty, as well as a satisfaction guarantee.

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To find out how good our decorative mirror doors are, we open and close them over 100,000 times. Funny, isn't that the same way you do it?

Sure, our mirror closet doors come in many styles and colors. But at Stanley, we believe a mirror door should be more than just decorative. It should also last. So we gave ours a twin-wheel top guide and an anti-jump track for smooth, reliable operation. This attention to detail led us to build screwdrivers with ergonomically designed grips for increased torque and exterior doors that stand up to hundreds of pounds of pressure. Building the best products around. It's the only way we've ever done things. And quite frankly, it's the only way we ever will.

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Fall
HOME REMODELING IDEAS

you don't have to keep switching between tools for different jobs.

Some specialized tools do just one thing well—but that one thing may be useful and often critical to a wide variety of tasks. "The right tool for the job" is a timeworn axiom that still applies today. And because such tools are so needed, they can usually be found in just about everyone's tool collection—tradesmen, home owners and housewives alike.

One tool that certainly fits this category is a staple gun tacker, such as the Arrow T50. Repairing window screens, hanging curtains, fastening materials to one another, installing carpeting or insulation, running stereo wiring and you-name-it, when only a staple will do, this is the tool that most people reach for. If you don't own one, it's almost a certainty that you eventually will.

A recent modification to the T50 has produced yet another innovative tool, the T75 Wiring Tacker, which is specially designed for installing non-metallic (NM) plastic jacketed electrical wiring. The sole plate of the T75 is shaped like a channel to fit over the wire, holding it flat and secure while a special type of staple is used to permanently fasten the wire in place. This one-step operation speeds the work of running wire and results in a safer, neater finished job. Its unique staple fasteners meet both U.S. and Canadian electrical code standards and are UL and Canadian UL listed for this application.

Choosing the right tool and buying the best quality materials especially applies when it's time to pick a paint for your home. There are two good reasons for this: You're painting because you want to protect your investment, and because you want your home to look its best. And there's

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You should also expect superior performance in the materials you use. Dulux Inspirations interior paints from Glidden are guaranteed for the life of your home, and new Accents decorative stains (inset) offer the same dependable quality as all other Minwax products.

Quality is just as evident on our new pedestal lavatory from Sterling, which is backed by the reputation of the Kohler Company. Assembling this type of sink is no problem when you know the pros' trick--attach the faucets and all hardware before you install it.

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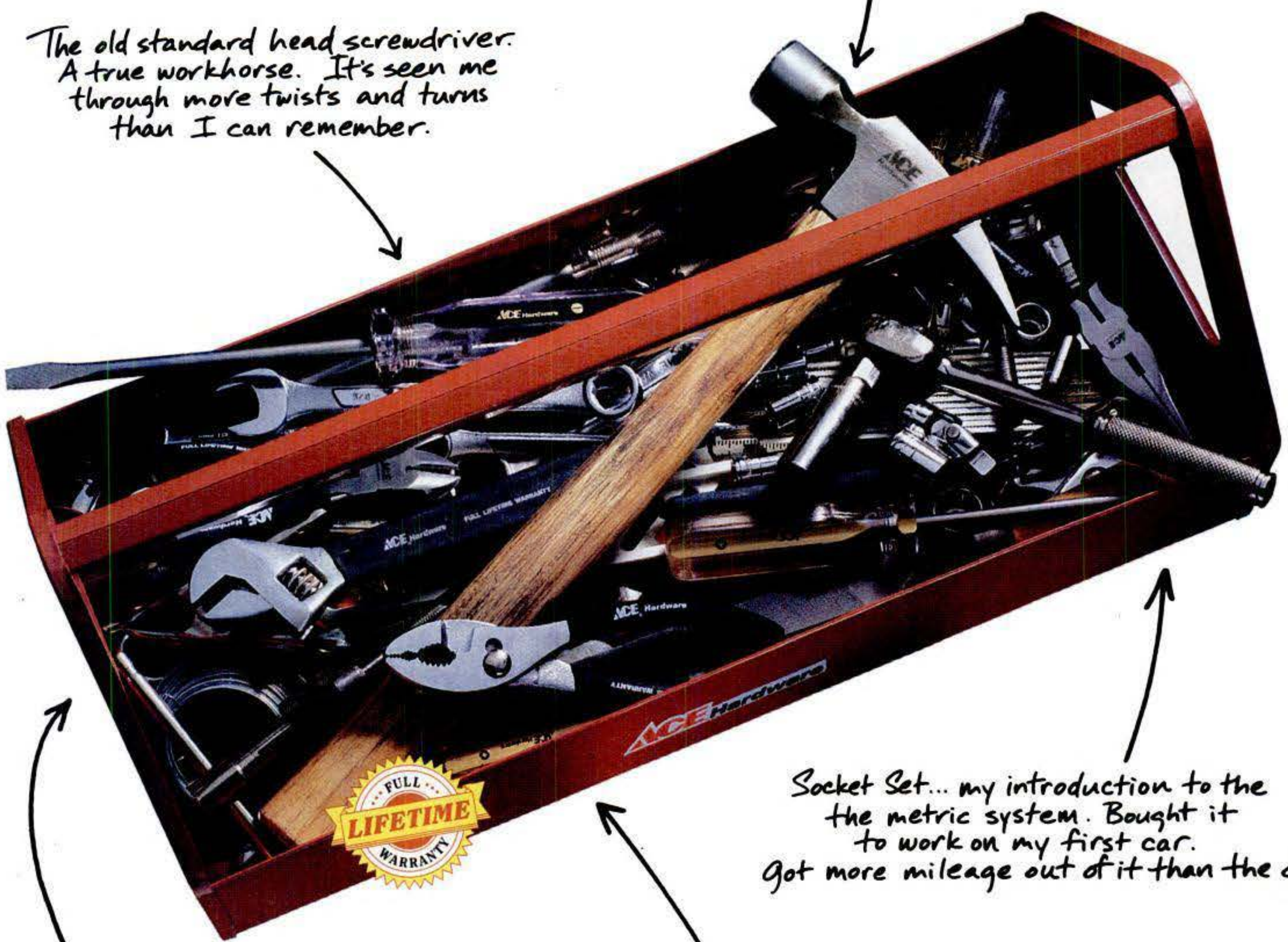
Let me tell ya, there's a lot of Life in my Ace Hand Tools...

Ah my hammer... over the past ten or twelve years it's pounded hundreds of nails, including the one on my left thumb.

The old standard head screwdriver. A true workhorse. It's seen me through more twists and turns than I can remember.



Socket Set... my introduction to the the metric system. Bought it to work on my first car. Got more mileage out of it than the car.

My trusty wrench. Sturdy and adjustable. We almost fixed the kitchen sink in '85. I did say almost, didn't I?

Pliers, got 'em before Fred moved next door in '82... lost 'em a couple years later... found 'em right after he moved. Coincidence? I don't think so.

Ace Brand hand tools are made with a full lifetime warranty. So you'll get plenty of use out of them and a few stories too. We guarantee it.

ACE® BRAND

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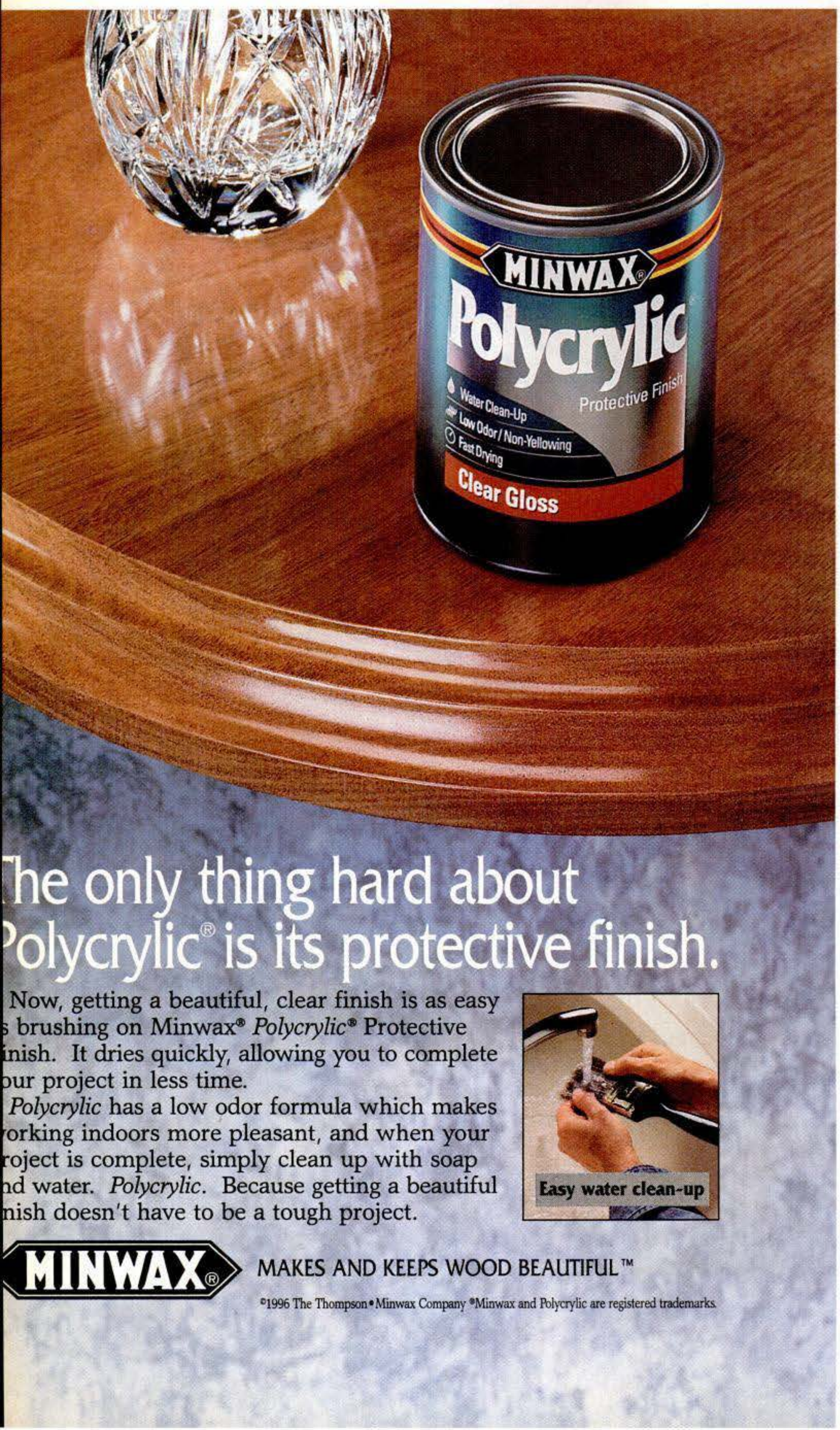
another reason, if you're doing the job yourself: You don't want to have to do it over if the paint you buy doesn't give you the results you expect.

There are a lot of paints on the market, and all manufacturers make the same claims for their products. So how do you choose one that will deliver the highest quality? It's easier than you think—simply buy the best products made by a reputable brand. For example, Glidden, a manufacturer that has earned its name with professional-quality products, offers an interior paint that is guaranteed for the life of your home—Dulux Inspirations. You can't go wrong with a promise like that. And this latex-base paint is easy to use. It covers with just one coat, dries quickly with low odor, and cleans up with soap and water. You can also test Inspirations under actual lighting conditions using ready-mixed Color Testers. These disposable 1.7-ounce bottles are available in 90 interior colors, each with a built-in brush that lets you paint a 2x3-foot "color swatch" in your own home. You won't have to buy a whole gallon just to find the right color to match your interior furnishings, and at the same time you'll know you're getting the best paint you can buy.



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Some home-renovation projects require as much careful attention to design detail as to the quality of the materials, and often these attributes are one and the same. Kitchen and bath fixtures are hard-working functional appliances, as well as decorative objects that stand prominently in the room, so it's important that they combine styling, durability, economy, and efficient operation in the same package. For all of these reasons, we chose a Sterling Southampton Deluxe Pedestal Lavatory for our remodeled bath.

To begin with, this unit is made of scratch- and chemical-resistant Grade A vitreous china, with a glass-smooth, high-gloss finish that's guaranteed not to fade or rust—all important considerations in any sink required to withstand years of daily use and maintenance. This model also has, in addition to its very smart contemporary styling, a unique pedestal design that conceals the water supply lines and drain, which makes for a more elegant finished look. And it has a generous basin that is more convenient for users, and a lot less messy than many typical pedestal-type sinks with smaller basins.

Installing a pedestal sink is a fairly easy process because there is no cabinet or counter work required. If you are doing extensive remodeling to the room, remember to remove a section of drywall where the unit will be located, and install a wood cleat to help secure and support the basin. All of the necessary mounting hardware should be included with the unit, as it was with our Sterling pedestal.

Just because the summer season is winding down, and your home's interior is getting its share of attention again, that doesn't mean there are no outdoor chores left to complete before winter closes in. A home's exterior

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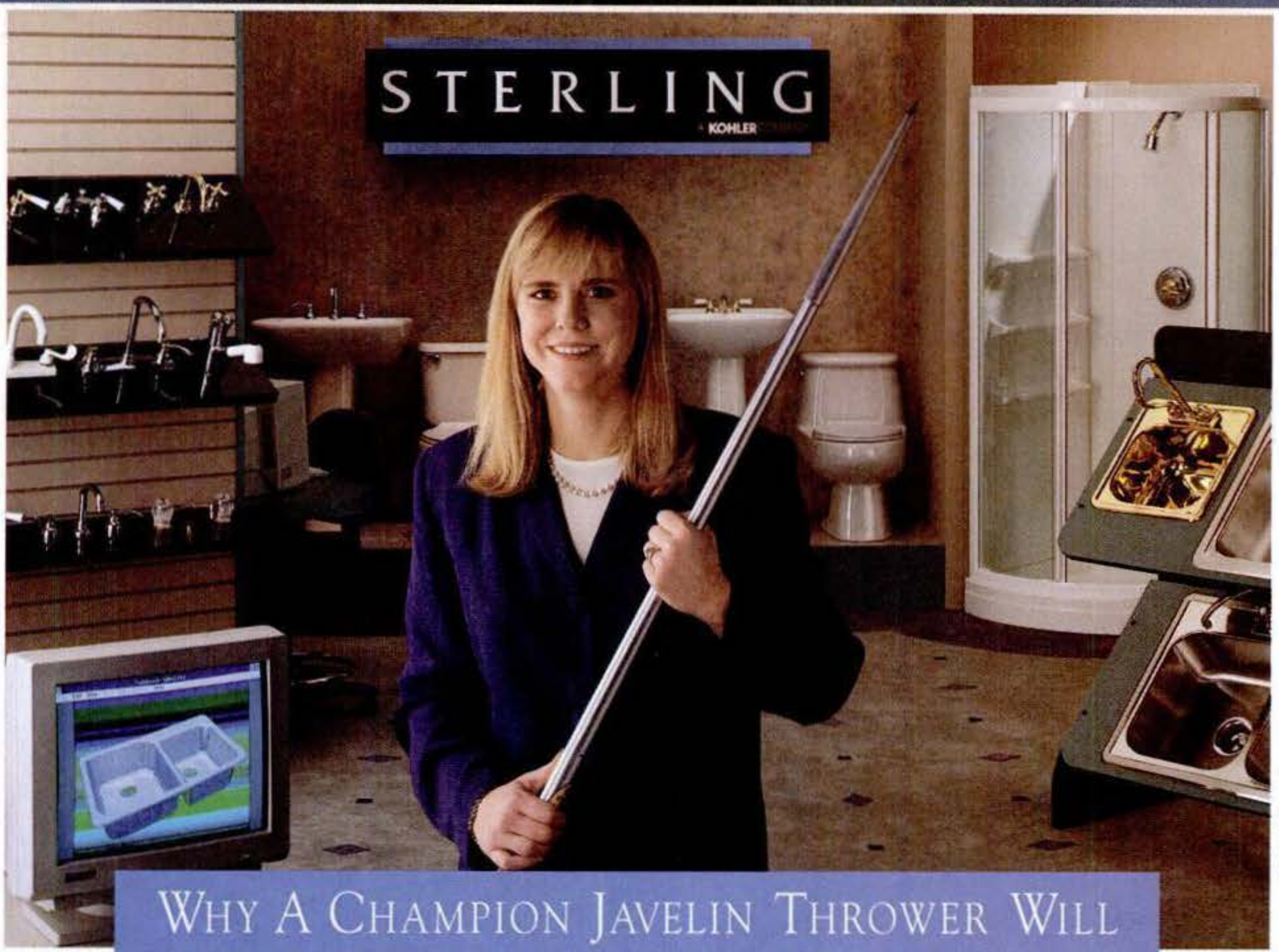

Kelly Wiederrecht
Manager
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For Some Great Decorating Ideas Or The Dulux Dealer Location Nearest You Call
1-800-ON-DULUX

Working off a ladder or up on a roof is certainly a lot easier today thanks to cordless battery-powered tools. Power to go, and power to spare, are just two reasons why this Sears Craftsman 14.4-volt cordless drill/driver sets a new standard in tools.

It's not difficult to replace gutters and downspouts with the Rainhandler Rain Dispersal System. Available in white or brown to blend invisibly into the roofline, these aluminum louvers let rainwater fall through but direct and disperse it safely away from house walls.

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The only thing more outstanding than its beauty is its durability.

While the beauty of Dulux® Endurance® paint may be outstanding, we also offer something just as extraordinary: a written guarantee. We also provide our Painter's Companion and Color Guide to further insure the home you create is one of lasting beauty. Or for further inspiration call 1-800-ON-DULUX.

Guaranteed for as long as you own your home.

Glidden

This photgraph has been color-enhanced to represent colors available in Glidden Dulux exterior paints, not that the house depicted was actually painted with these products.

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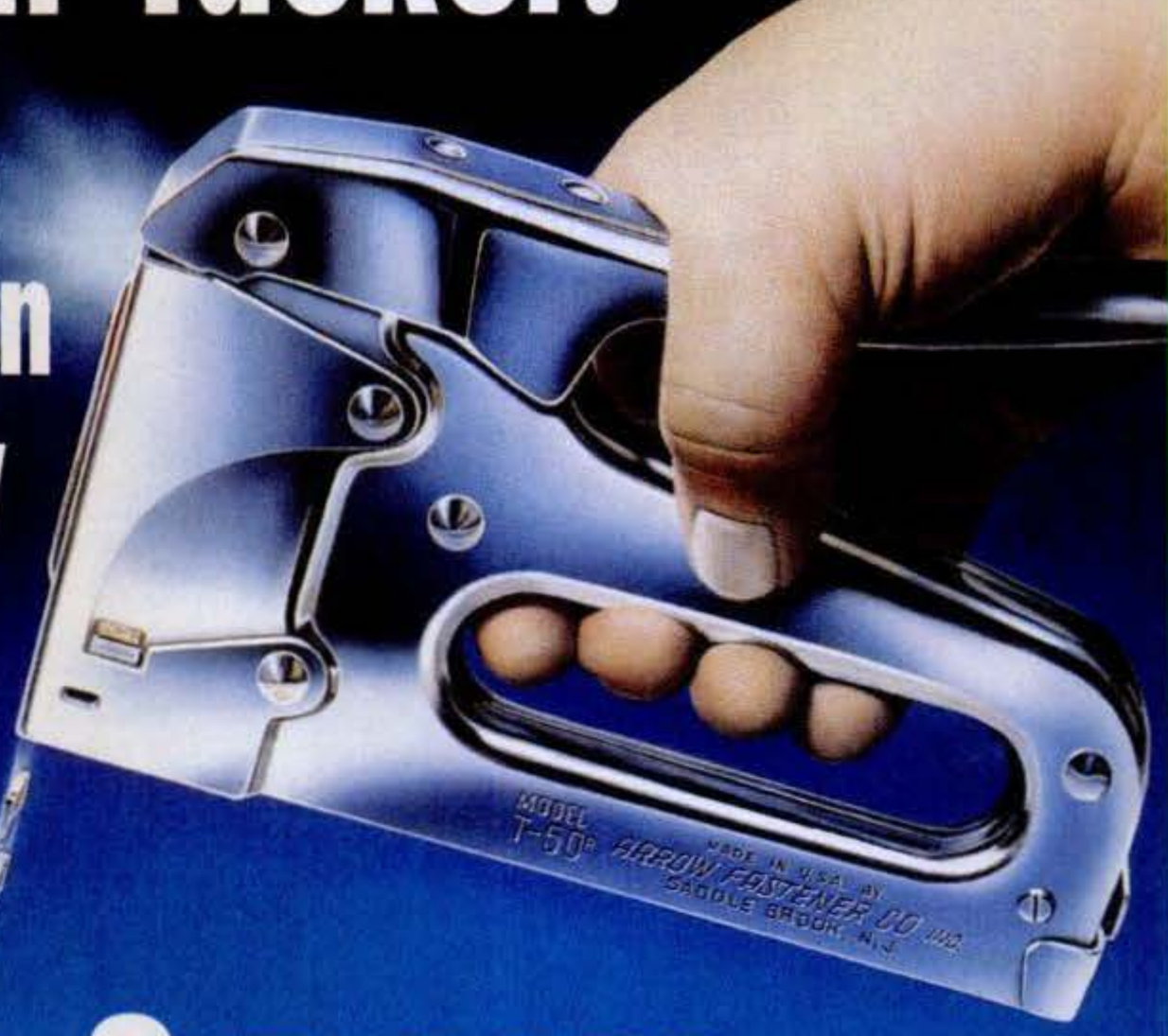
ARROW® Introduces

The New Improved T50®

Staple Gun Tacker!



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Fall HOME REMODELING IDEAS

defenses must be in good shape to last through the winter, when outside repairs are difficult at best and often impossible to attempt during freezing weather. One traditional task that most homeowners have to contend with at this time of year is cleaning out the gutters and downspouts—a job we no longer worry about since installing the Rainhandler Rain Dispersal System on our house.

Rainhandlers are a unique, easy-to-install alternative to conventional gutter systems. Instead of troughs and drainpipes, which typically clog with leaves, twigs and other debris, Rainhandlers are 5-foot-long aluminum louvers that replace gutter systems entirely. Installed in a continuous run below the roof edge, they intercept rainwater and melting snow but do not catch and carry it like gutters. Instead, the louvers break up the flow into rain-sized droplets and deflect those droplets away from the house walls. The water is dispersed over a wider area where it can be more easily absorbed by plants or diverted farther away from the walls by landscaping. Because Rainhandlers don't collect the water, they don't clog—any debris that falls on the louvers is quickly washed off or blown away by the wind.

Another exterior project any homeowner should consider, before winter sets in, is installing an automatic garage door opener. If you already own one, take a look at the new features today's best openers have—particularly new operating safety features if you have children or pets. If your garage doesn't have an automatic opener, you may not realize just how much you're missing. For one thing, having one of these units means getting out of your car inside a dry, relatively warm garage—instead of out in the rain and snow. Yet another benefit to

continued on page 90

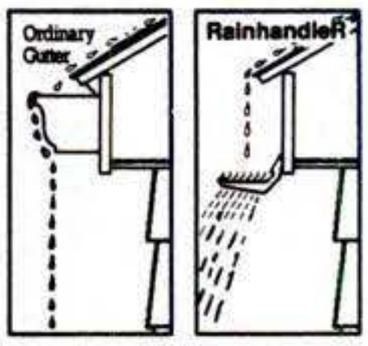
For a unique styling touch, we combined two Minwax Accents decorative stains (inset) on our remodeled bath's wood fixtures and baseboard trim. A topcoat of Minwax Polycrylic gives the wood a protective, crystal-clear finish to help resist water damage.

GET RID OF YOUR GUTTERS!

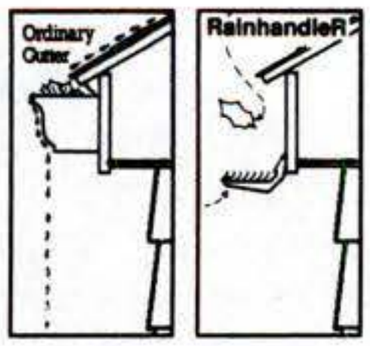
THEY CLOG, LEAK, FREEZE, RUST AND ROT.

Replace them with the

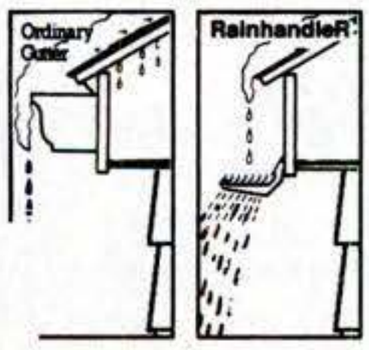
RAINHANDLER



STOP CLOGGING.
RainhandleR needs no cleaning, because it can't clog. Its patented louvers break up roof water into a spray of tiny drops and disperse them away from your house.



STOP CLEANING.
You'll never climb a shaky ladder again to clean a gutter. **RainhandleR** comes clean with a quick blast from your garden hose–from ground level.



STOP WATER DAMAGE.
RainhandleR in winter, protects your investment by helping to prevent clogs and ice dams on the roof that otherwise lead to water rot and leaks.

RainhandleRs are installed on homes nationwide. They can be installed on yours in about 3 hours with a screwdriver. **RainhandleR** is virtually invisible, rustproof and comes in white, brown or natural aluminum. For more information send coupon to **RainhandleR** or call 1-800-942-3004; or FAX 1-800-606-2028 or E-MAIL: Rainhandle @ AOL.Com

Some distributor territories available

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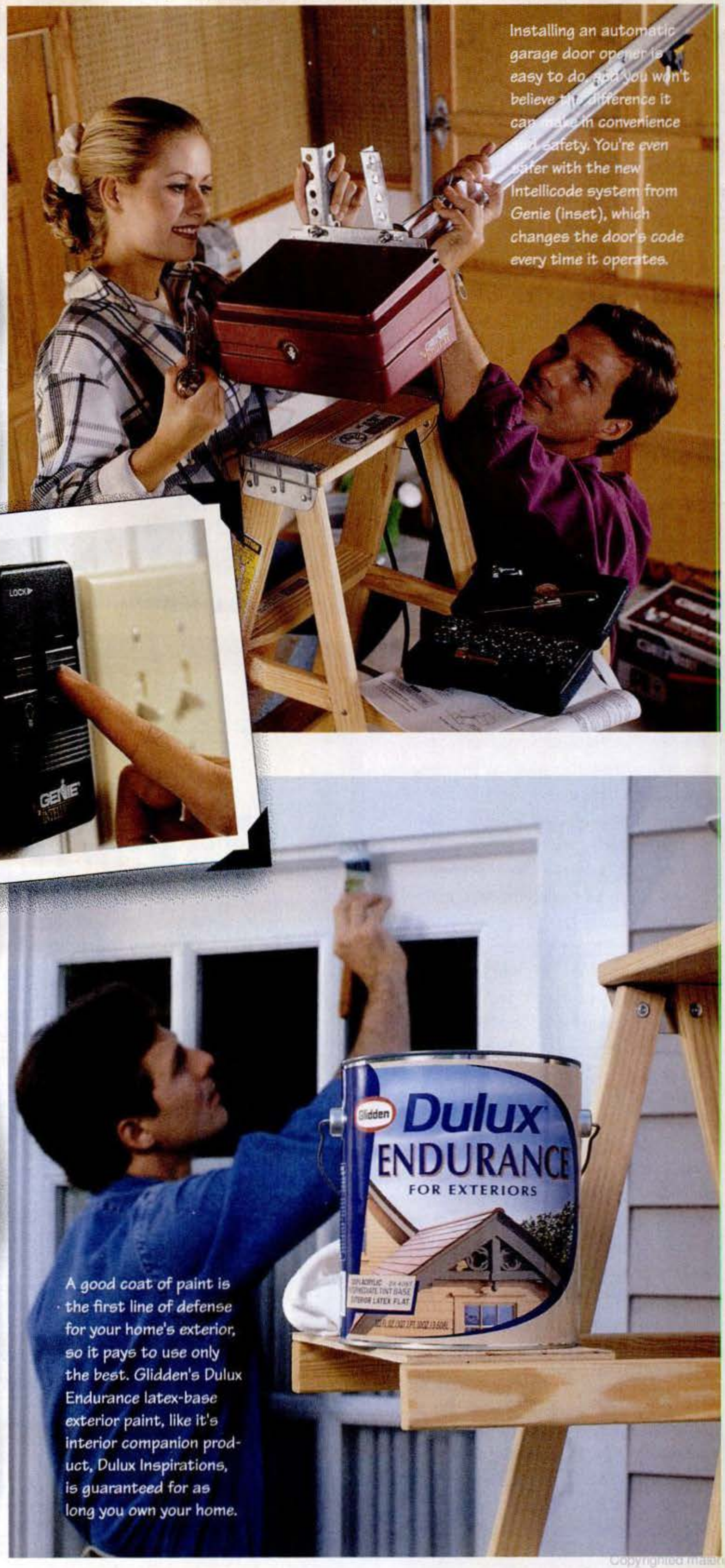
Fall
HOME REMODELING IDEAS

automatic openers is security—you won't have to stop and get out in a dark driveway to roll up the door. And then there's the pure convenience of it all—you just push a button and let the operator do the work, while you sit safe and comfortable in your car.

And now automatic garage door openers are safer that ever, with the recent introduction of the Genie Intellicode system. Its sophisticated "rolling code" operation prevents the latest wrinkle in high-tech theft—electronic code stealing. Most people don't realize it, but every time a radio-frequency signal is sent to open or close an automatic door, that signal is vulnerable to code piracy. The Intellicode foils this by selecting a new code each time it is activated, and it randomly chooses the new code from among 4.3 billion possible combinations. And no thief, no matter how smart or well-equipped, could predict what that number would be.



Installing an automatic garage door opener is easy to do, and you won't believe the difference it can make in convenience and safety. You're even safer with the new Intellicode system from Genie (inset), which changes the door's code every time it operates.

A good coat of paint is the first line of defense for your home's exterior, so it pays to use only the best. Glidden's Dulux Endurance latex-base exterior paint, like it's interior companion product, Dulux Inspirations, is guaranteed for as long you own your home.

Everyone needs help and advice once in a while, especially when you're doing a job or working with materials and tools you've never used before. Sometimes you just need a little "refresher course" in something you haven't done lately. This is especially true with many home-improvement projects, even for experienced homeowners. So where do you get this help? By tradition, most people go to their local store or supplier.

Of course, things have changed. Many neighborhood Mom & Pop hardware stores have been replaced by huge home centers, which boast plenty of inventory but are usually short on personality—and personal assistance. It's hard to ask for advice about installing a fixture or choosing the right tool when you're standing in a big, busy barn of a store, and where salespeople may know where everything is, but not how it's supposed to be used.

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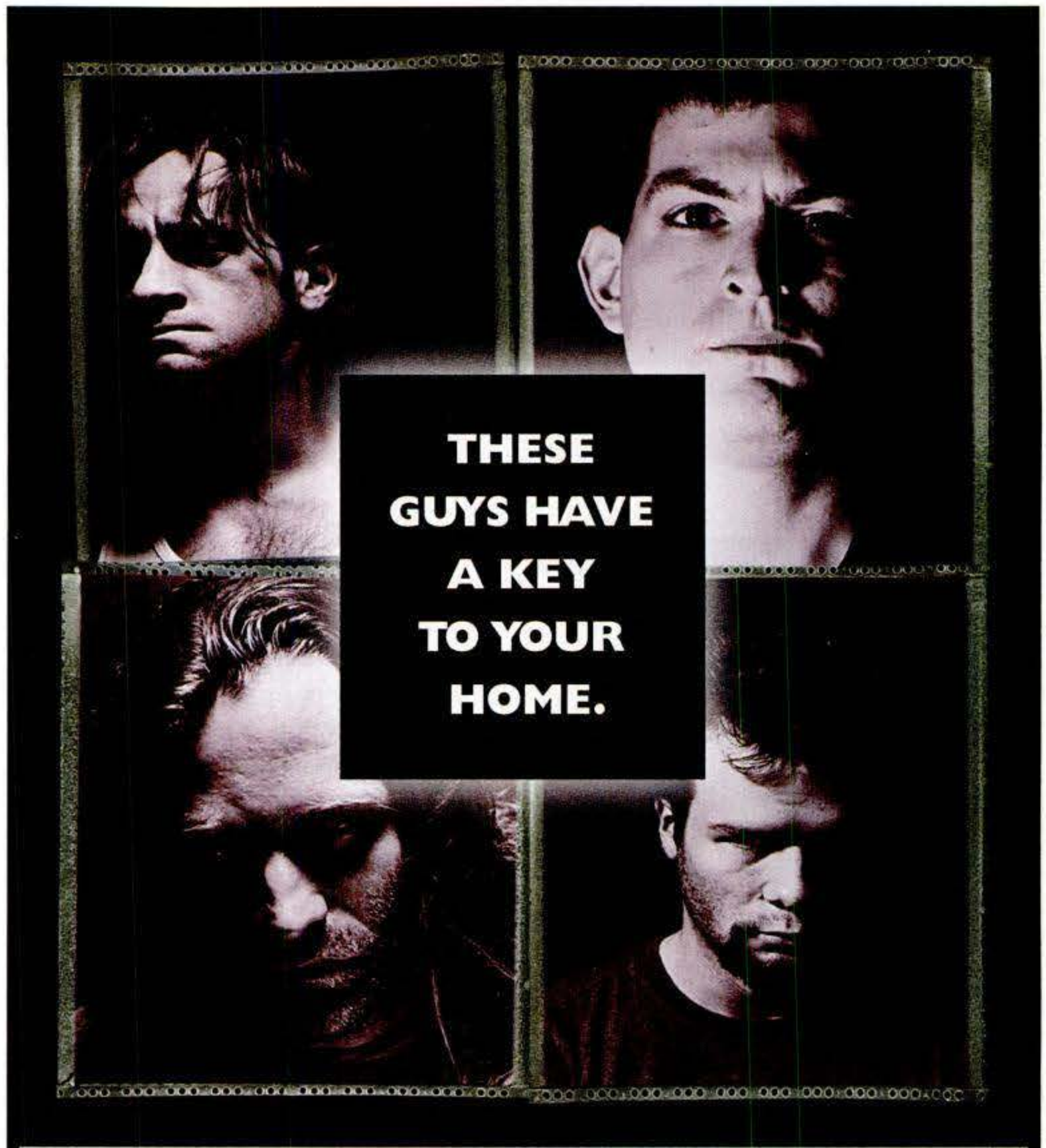
There are places, however, where you can still find people who take a personal interest in their customers—because those people own and operate their stores. Ace Hardware stores are a national chain of owner-operated businesses. As a group they have greater purchasing power, which they pass on to their customers in low prices. And Ace tools and products also offer superior quality. Ace hand tools carry a lifetime warranty, and Ace Brand items are tested and certified to be as good as, if not better than, the leading national brands. So the next time you need advice, go to someone you know, and who you know will provide you with products you can trust.

It doesn't happen often, but now and then something really new comes along that makes a significant difference in the outcome or look of a home-remodeling project. It can be a new material, a completely new design, or a new palette of colors. It might do a familiar task in a remarkable new way. And by incorporating it into your project, it helps you to create something truly special.

We found a brand-new product for our bath remodeling project that did just that—and more. We had wanted to give the room more modern fixtures and an up-to-date look, yet we also wanted to retain some of the traditional warmth and appearance of the rest of our home. Hardwood trim and moldings with a natural wood finish helped to accomplish that, but a natural stain would not, by itself, add anything more to heighten the decor. The answer to our problem was new Minwax Accents, a decorative stain that enhances the look and natural grain of wood like a typical stain finish, but does it with color. Eight richly different colors are available, in fact, from Olive Green to Vintage Burgundy to Classic Black. Applied like ordinary wood stain, Accents may be used alone, in combination with other Accents colors or with natural finishes. We chose Hunter Green and Midnight Blue to offset the natural Early American wood tone on our room's baseboards and the decorative wood shelves and towel bars. The look is unique, and it suits both our sense of tradition as well as style. ■



Criminals are getting smarter. And you could be their next victim. Thieves are using a hi-tech device to copy the radio signal your remote control sends to your garage door opener. It's easy to get, and easy to use. It's like having an electronic key to your home. That's why we introduced the Genie® Intellicode™ garage door opener. Its rolling code technology will change the radio code every time you press the button. A copied signal is useless. *Your* opener will only respond to *your* remote. And that means your loved ones and possessions are protected. For the name of your local Genie dealer or installer, just call 1-800-87-GENIE.

WITH GENIE INTELLICODE YOU CAN LOCK THEM OUT.

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FYI

EDITED BY CECILIA WESSNER

ASK POPULAR SCIENCE

TATTOO BY C. COOLEY

Why doesn't a tattoo simply fade away as the skin sloughs off?

Ed Kraynak
Chicago, Ill.

A TATTOO is made by injecting pigment into the second layer of skin, the dermis, which lies just below the epidermis, or top layer that is constantly being replaced. According to Dr. Linda Lutz, assistant professor of dermatology at the University of Maryland School of Medicine, pigment can remain in the dermis or be picked up by cells located there, called macrophages.

Macrophages can digest pigment particles that are not too big. Or they can slowly transport the particles to a deeper region of the dermis, causing the tattoo to fade. Some pigment will be delivered to lymph nodes where it will be broken down over time, again making the tattoo fade.

Lasers eliminate tattoos by breaking the pigments into smaller particles, enabling macrophages to dispose of them quickly.

What happens to a computer file when it gets deleted?

Jeremy Howard
dhoward@ally.ios.com

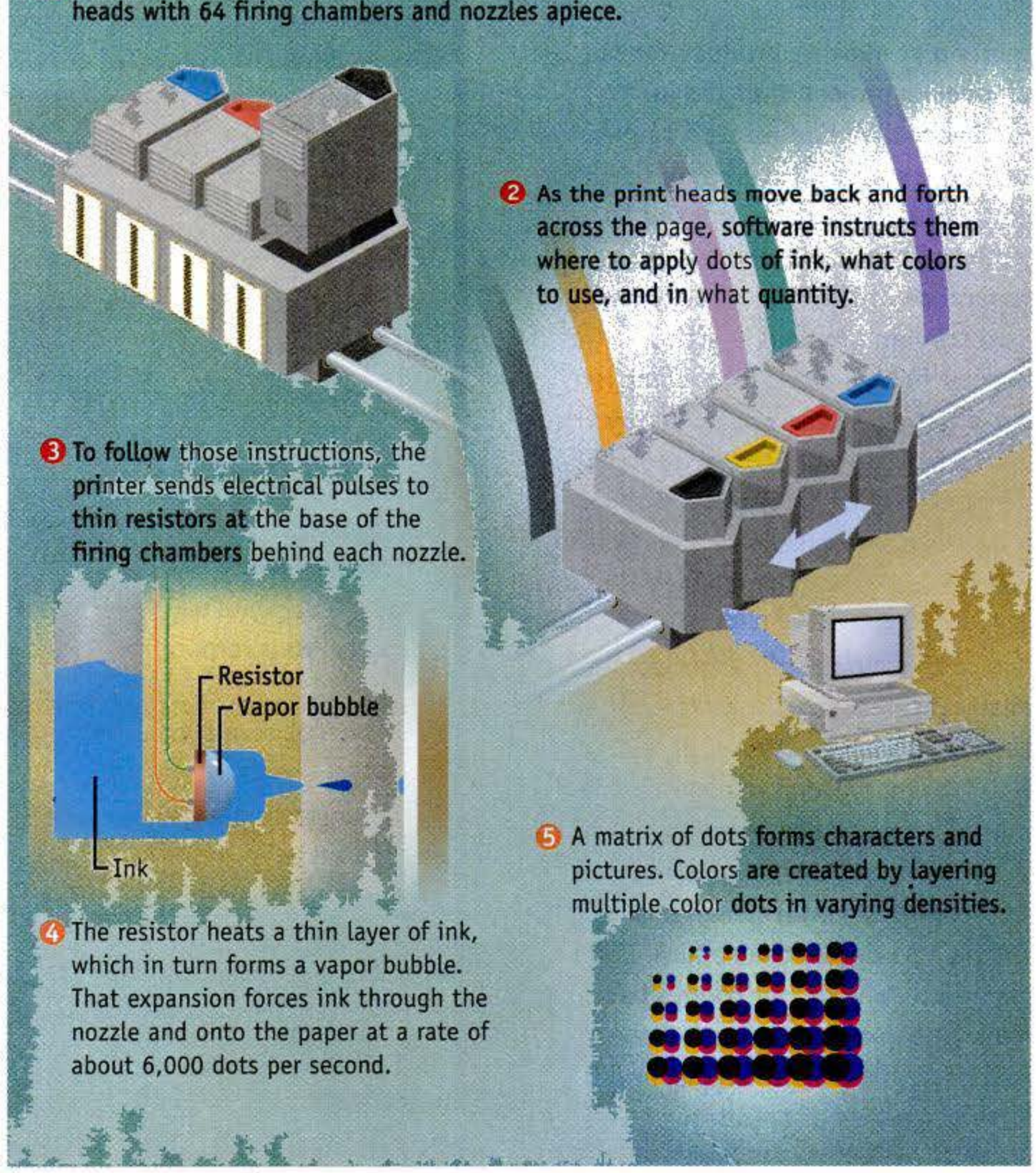
ACTUALLY, VERY little happens, since hard disks typically don't "erase" files, even when you tell

HOW IT WORKS

K. DANIEL CLARK

Color Inkjet Printer

COLOR PRINTERS HAVE become better and less expensive recently, thanks to inkjet technology. The components and procedures vary from one inkjet model to the next, but the core technology is the same: Liquid inks are sprayed onto paper through tiny nozzles. Some printers use one cartridge to hold the black and color inks. Others use one for black and another for the three colors (cyan, magenta, yellow) that form all other hues. Still others, such as the Canon BJC-610 shown below, use four separate ink cartridges.—*Chris O'Malley*



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them to. Instead, they simply remove them from their index of active files; operating systems treat erased files similarly. A file is not lost until new data is written on the spot occupied by the "deleted" file. That's why it's possible to rescue, or "unerase," some files. In baseball terms, the file is scratched from the active roster, but it will remain seated on the bench until it is bumped off by another player.

With MS-DOS and Windows 3.x systems, you had to use a program such as The Norton Utilities to resurrect "deleted" files (although later versions of DOS included an unerase feature). But the process of recovering files has gotten much easier in Windows 95 systems. Windows 95 automatically copies "deleted" files to a Recycle Bin folder—a safeguard Macintosh systems have long employed with the Trash Can feature. To get back a file you've accidentally deleted, you simply retrieve it from the Recycle Bin. Even once you've "emptied" the bin, it's possible to recover a file with the aid of a utility program. Symantec's latest version of Norton Utilities can do this, for example, and it can also detect deletions that Windows 95's Recycle Bin might miss, such as those performed within certain applications or within a DOS window.

If the neutrons of an atom do not have a charge, then why are they necessary? What purpose do they serve in the structure of an atom?

Wade Price
DIX36@aol.com

NEUTRONS KEEP the atomic nucleus from flying apart. If the nucleus of an atom contained only protons, these positively charged particles would repel each other so strongly that the nucleus would disintegrate.

Except for hydrogen, which has only one proton, there are no stable nuclei that do not contain both protons and neutrons. The neutrons exert a strong but short-range force, called the nuclear force, that overcomes the repulsive force experienced by the protons. The stability of the nucleus is a delicate balance between these two forces.

What is acid rain and how is it formed?

Du Lo Xuan
via e-mail

USUALLY, ACID rain starts with the burning of fossil fuels, such as oil,

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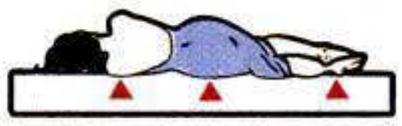

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With a Select Comfort Sleep System, you can each get the firmness you want.

Tests show it also helps support your spine close to its natural alignment, which can lower the tension in the surrounding muscles. So you can sleep comfortably in most any position and wake feeling great!

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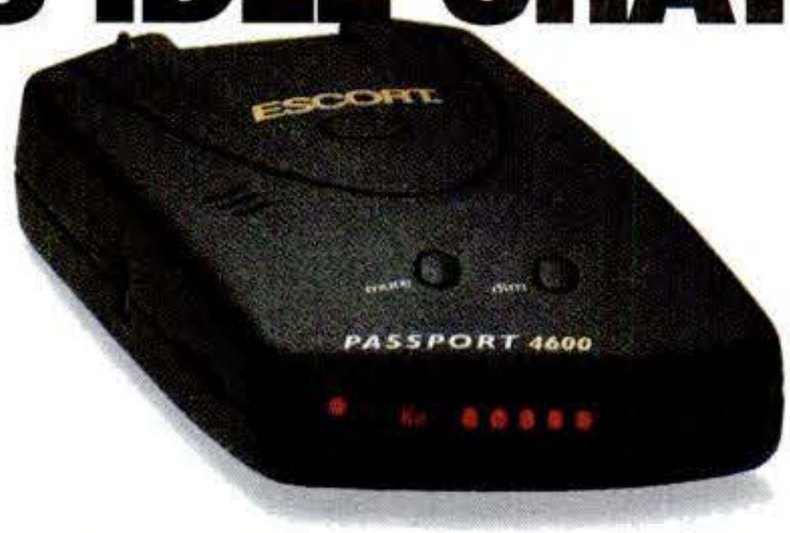

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coal, and gas, which releases nitrogen and sulfur oxides into the air. Through chemical reactions, these oxides become nitric and sulfuric acid. Other compounds, such as hydrochloric and organic acids, can appear in rainfall as well, says Paulette Middleton of Science and Policy Associates, a scientific consultant to government and industry based in Boulder, Colorado. These acids enter the air through industrial emissions and appear only in minute amounts. Sometimes, however, these acids fall without being mixed with rain, especially in dry areas of the western United States.

Why does ice float?

Ron Landphair
Ames, Iowa

ICE FLOATS because of a peculiar characteristic of water: As water approaches its freezing point—32°F or 0°C—it expands. The result is that ice is less dense than water, so it floats. We remember discovering this simple property of water in grade school: We put a plastic bucket of water outside overnight to create a big block of ice. In the morning, the bottom of the bucket had a huge hole in it where the expanding, freezing water had pierced it. (By the way, there are many kinds of ice, each with different densities and other properties.)

What is in concrete, and why do they have to mix it?

Dave Ritter
via e-mail

CONCRETE IS MADE of two basic parts: aggregates, which include sand and gravel, and paste, formed from water, air, and cement. Cement itself has four main ingredients: lime, silica, clay, and iron. Concrete is mixed so that all the ingredients are evenly distributed.

When the dry ingredients are combined slowly with water, a reac-

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YOU CAN MAKE UP TO

$9,800 in 24 Hours!

Dear Friend,

I made $9,800 in 24 hours. You may do better!

My name is John Wright. Not too long ago I was flat broke. I was $31,000 in debt. The bank repossessed my car because I couldn't keep up with the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in Southern California. The one I'm living in now in Bel Air is worth more than one million dollars. I own several cars, among them a Rolls Royce and a Mercedes Benz. Right now, I have a million dollar line of credit with the banks and have certificates of deposit at $100,000 each in my bank in Beverly Hills.

Best of all, I have time to have fun. To be me. To do what I want. I work about 4 hours a day, the rest of the day, I do things that please me. Some days I go swimming and sailing—shopping. Other days, I play racquetball or tennis. Sometimes, frankly, I just lie out under the sun with a good book. I love to take long vacations. I just got back from a two week vacation from—Maui, Hawaii.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or maybe even bankrupt. It was only through this amazing money secret that I could pull myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all—peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you $20.00 in cash. (I'm giving my address at the bottom of this page.) I figure, if I spend $20.00, I get your attention. And you will prove it to yourself this amazing money secret will work for you, too!

Why, you may ask, am I willing to share this secret with you? To make money? Hardly. First, I already have all the money and possessions I'll ever need. Second, my secret does not involve any sort of competition whatsoever. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest *legal* way to make money that has ever been invented!

This is a very safe way to get extra cash. It is practically risk free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm or anywhere in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made $45,000 *in one year.*

This secret is simple. It would be hard to make a mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made $2 million *in just 3 years.*

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done whether you're a teenager or 90 years old. I know one woman who is over 65 and *is making all the money she needs* with this secret.

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After you get started you can probably do everything that is necessary in three hours per week.

Here's what newspapers and magazines are saying about this incredible secret:

The Washington Times:
The Royal Road to Riches is paved with golden tips.

National Examiner:
John Wright has an excellent guide for achieving wealth in your spare time.

Income Opportunities:
The Royal Road to Riches is an invaluable guide for finding success in your own back yard.

News Tribune:
Wright's material is a MUST for anyone who contemplates making it as an independent entrepreneur.

Success:
John Wright believes in success, pure and simple.

Money Making Opportunities:
John Wright has a rare gift for helping people with no experience make lots of money. He's made many people wealthy.

California Political Week:
...The politics of high finance made easy.

The Tolucan:
You'll love...*The Royal Road to Riches.* It's filled with valuable information...only wish I'd known about it years ago!

Hollywood Citizen News:
He does more than give general ideas. He gives people a detailed A to Z plan to make big money.

The Desert Sun:
Wright's *Royal Road to Riches* lives up to its title in offering an uncomplicated path to financial success.

PROOF

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their initials have been used In order to protect their privacy, but I have full information and the actual proof of their success in my files.

'More Money Than I Ever Dreamed'

"All I can say—your plan is *great!* In just 8 weeks I took in over $100,000. More money than I ever dreamed of making. At this rate, I honestly believe, I can make over a million dollars per year.

A. F., Providence. RI

'$9,800 In 24 Hours'

"I didn't believe it when you said the secret could produce money the *next morning.* Boy, was I wrong, and you were right! I purchased your *Royal Road to Riches.* On the basis of your advice, $9,800 poured in, in less than 24 hours! John, your secret is incredible!"

J. K., Laguna Hills, CA

'Made $15,000 In 2 Months At 22'

"I was able to earn over $15,000 with your plan—in just the past two months. As a 22 year old girl, I never thought that I'd ever be able to make as much money as fast as I've been able to do. I really do wish to thank you, with all of my heart."

Ms. E. L., Los Angeles, CA

'Made $126,000 In 3 Months'

"For years, I passed up all the plans that promised to make me rich. Probably I am lucky I did—but I am even more lucky that I took the time to send for your material. It changed my whole life. Thanks to you, I made $126,000 in 3 months."

S. W., Plainfield, IN

'Made $203,000 In 8 Months'

"I never believed those success stories...never believed I would be one of them...using your techniques, in just 8 months, I made over $203,000...made over $20,000 more in the last 22 days! Not just well prepared but simple, easy, fast...John, thank you for your *Royal Road to Riches!"*

C. M., Los Angeles, CA

'$500,000 In Six Months'

"I'm amazed at my success! By using your secret I made $500,000 in six months. That's more than twenty times what I've made in any single year before! I've never made so much money in such short time with minimum effort. My whole life I was waiting for this amazing miracle! Thank you, John Wright."

R. S., Mclean, VA

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember—I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this—so far this amazing money producing secret makes the profits from most other ideas look like peanuts!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "The Royal Road to Riches". Some call it a miracle. You'll probably call it "The Secret of Riches". You will learn everything you need to know step-by-step. So you too can put this amazing money making secret to work for you and make all the money you need.

To prove this secret will solve all your money problems, don't send me any money, *instead postdate* your check for a month and a half from today. I guarantee not to deposit it for 45 days. I won't cash your check for 45 days before I know for sure that you are completely satisfied with my material.

$20.00 FREE!

There is no way you can lose. You either solve all your money problems with this secret (in just 30 days) or you get your money back *plus* $20.00 *in cash* **FREE!**

Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original UNCASHED CHECK, but I will also send you an extra *$20.00 cashiers check* just for giving the secret an honest try according to the simple instructions.

I GUARANTEE IT! With my unconditional guarantee, there is absolutely NO RISK ON YOUR PART.

To order, simply write your name and address on a piece of paper. Enclose your postdated check or money order for $29.95 and send it to:

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SWORN STATEMENT:

"As Mr. John Wright's accountant, I certify that his assets exceed one million dollars." Mark Davis

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YOU'VE GOT SEVEN GOOD REASONS TO MAKE THIS CALL.

In this issue is a brochure that reveals the seven key advantages of Sony-brand DSS® Receivers. For more information and the name of the retailer nearest you, call 1 800 838-7669.

tion takes place that's known as hydration, during which the water molecules combine with the fine cement particles and form a solid that holds the aggregates. As Todd Watson of the American Concrete Institute points out, concrete hardens not from drying but from this process of hydration.

I understand that Earth is about 22,000 miles in diameter and also that a geocentric orbit is about 22,000 miles. Is there a relationship?

Vince Broesch
via e-mail

YOU ARE CONFUSING Earth's diameter with its circumference. The diameter—the length of an imaginary line from one side of Earth's surface through the core to the other side—is about 7,926 miles. Its circumference—the planet's girth at the equator—is about 24,902 miles.

A geostationary satellite (one that remains positioned above a fixed point on Earth) orbits approximately 22,240 miles above the equator. There is no correlation between Earth's circumference and a geostationary satellite's orbit. If, for example, Earth had more mass, it would have a greater gravitational pull on objects in space, and would require a different orbit for a satellite to remain geostationary.

What is the difference between magnetic north and "true" north?

Neil Todd

TRUE NORTH IS the North Pole, the place where Santa Claus is supposed to live. Magnetic north is somewhat south of that—the place where Earth's magnetic field has its north pole. When measured in 1984, magnetic north was at 77.0 degrees North and 102.3 degrees West—off the eastern tip of Lougheed Island, Northwest Territories, Canada. This position is an average location. Magnetic north moves every day in an elliptical path around this average. In fact, magnetic north itself has been moving north and west over the past century and a half that it has been tracked. As electrical currents in Earth's molten core fluctuate, so does the position of magnetic north.

What's the difference between a CD-ROM and an optical disc?

CLC2166@aol.com

TECHNICALLY, THERE is no difference—a CD-ROM is one type of optical disc. Music CDs are another. In each case, the drive or player uses a laser to project a beam of light (hence, the "optical" reference) onto a specially coated plastic disk. It then interprets the pattern of reflections as a stream of ones and zeros that represent digital data, which could be a computer

What's on PopSci Online

POPULAR SCIENCE is giving you more on the World Wide Web, including:

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document or a musical recording.

There is, however, a difference between these discs and what are known as write-once and rewritable optical discs. CD-ROMs and music CDs are "read-only" discs—that is, you can play them but not record on them.

With write-once systems, also known as WORM (write-once-read-many-times) drives and CD-ROM recorders, a laser records data by etching pits into the surface of a disc, which can then be read back but not altered. Rewritable optical drives typically use a hybrid technology known as magneto-optical (MO), which combines the magnetic recording techniques used in hard disk drives with the precision of optical drives. In MO drives, a laser beam heats a crystalline metal alloy until its crystals are loose enough to be moved by a magnetic field created by a write head. The alignment of the crystals indicates either a "1" or "0" for digital data.

What elements other than mercury are liquid at room temperature?

Roy Blackmix
via e-mail

IF YOU CONSIDER room temperature to be between 68°F and 70°F, there's one other: bromine. Cesium and gallium have the next highest melting points, at 83°F and 85.6°F, respectively.

What do the numbers 20/20 refer to when describing eyesight?

R. A. MacLaren
via email

HAVING 20/20 vision doesn't mean your eyesight is "perfect," it simply means it conforms to an optometric standard. The numbers describe the distance, measured in feet, at which a person can see an object, usually a specifically sized letter of the alphabet, clearly enough to distinguish it. The first number refers to the standard—a "normal" eye seeing the object clearly at 20 feet. The second number helps us reference how much the eye falls short of the standard. So, for example, a person with 20/200 vision would find it as difficult to read a sign that's 20 feet away as a normally sighted person would reading the same sign 200 feet away. A person with particularly sharp eyes might have 20/15 vision, meaning he or she can see an object as clearly from a distance of 20 feet as a person with normal vision would from 15 feet.

How does your body keep from falling off the bed at night even if you are sleeping on an unfamiliar bed, or even a couch?

Cesar Naranjo
via e-mail

SIMPLE: YOUR body essentially shuts off its skeletal muscles during most of the time you're asleep, when it shifts between the dream state, called rapid eye movement (REM) sleep, non-REM sleep, and brief periods of wakefulness. As the night goes on, REM sleep periods get longer and non-REM sleep gets shorter, says Quentin Regestein, director of the Sleep Clinic at Brigham and Women's Hospital in Boston. Under normal conditions, the body remains inactive from the neck down during REM sleep, except for vital functions such as heartbeat and breathing. Although the restriction of movement lessens somewhat during non-REM sleep, the brain still suppresses impulses like walking and rolling off the bed. These inhibitions take years to develop, however. That's why children are more likely to roll off their beds.

How does tomato juice get rid of bad smells?

Joni Stegeman
Skokie, Ill.

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one. We put your question to a number of tomato experts and food chemists. Though most had heard that tomato juice can remove odors, none of them was certain that it actually does this, or could offer a solid scientific explanation.

Tomato juice has long been used to deodorize pets that lose a battle with a skunk. Unfortunately, it doesn't do much other than make Poopsie pink. "It's probably the scrubbing action, rather than something in the juice itself, that gets rid of the odor," says Paul Krebaum, a chemist at Molex, Inc. in Lisle, Illinois. Eau de skunk has pungent sulfur-containing compounds called thiols, and getting rid of the smell means breaking up these compounds with a strong oxidizing agent like hydrogen peroxide. Here is Krebaum's de-skunking recipe, described in our August 1995 Science and Technology Newsfront: To one quart of 3 percent hydrogen peroxide, add one-quarter cup of baking soda and one teaspoon of liquid soap. Wash your smelly pet with this concoction, then rinse with tap water.

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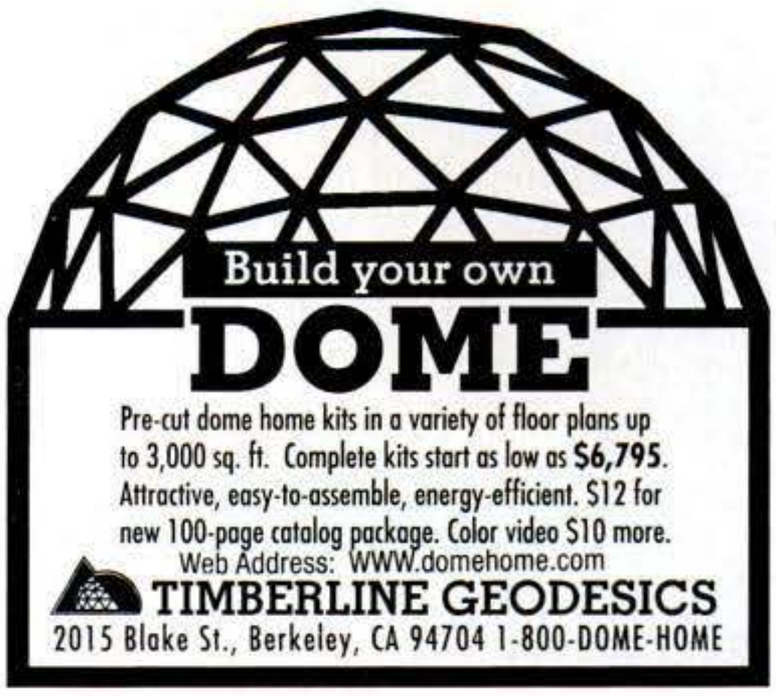

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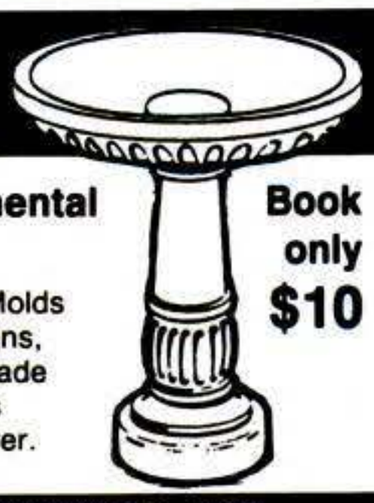

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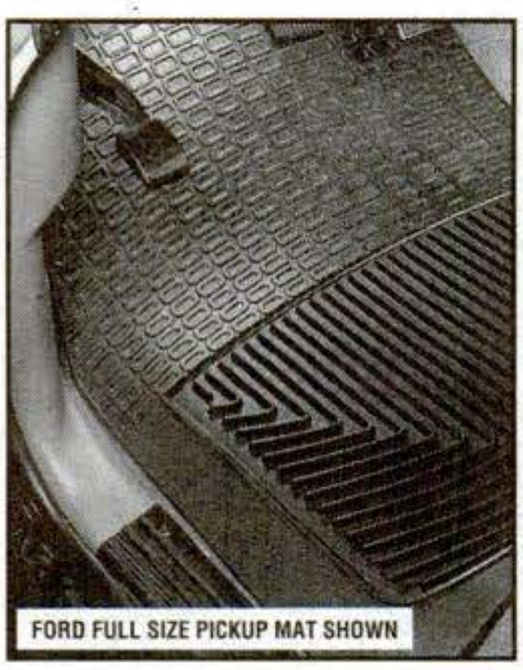
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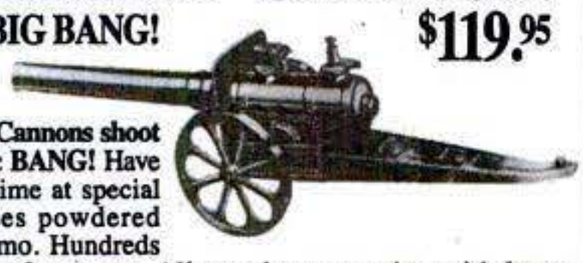

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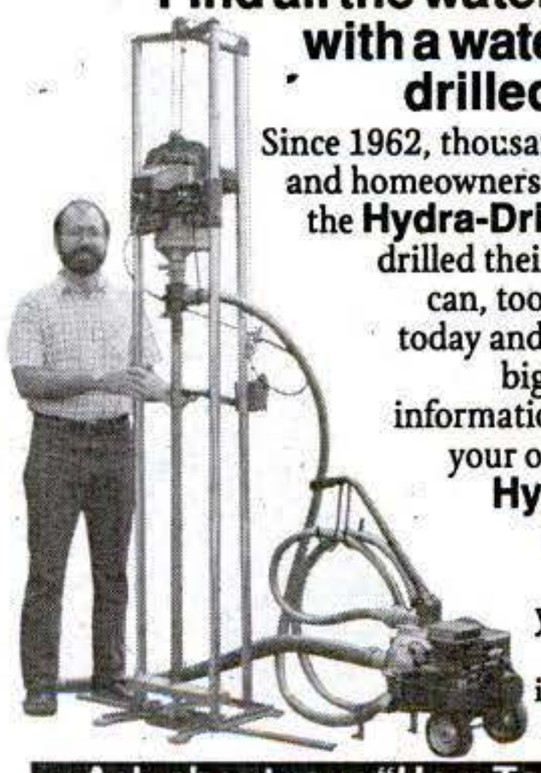

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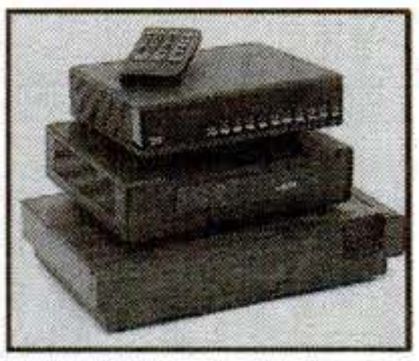

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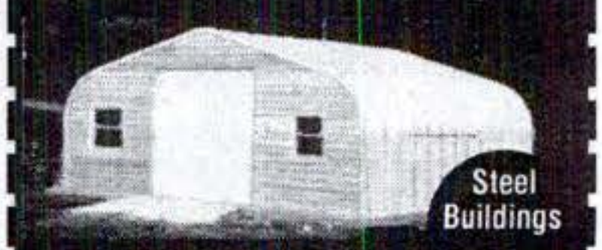

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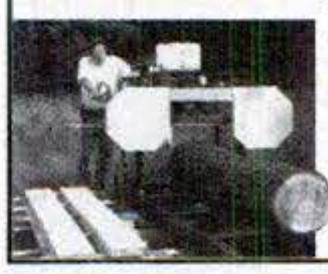

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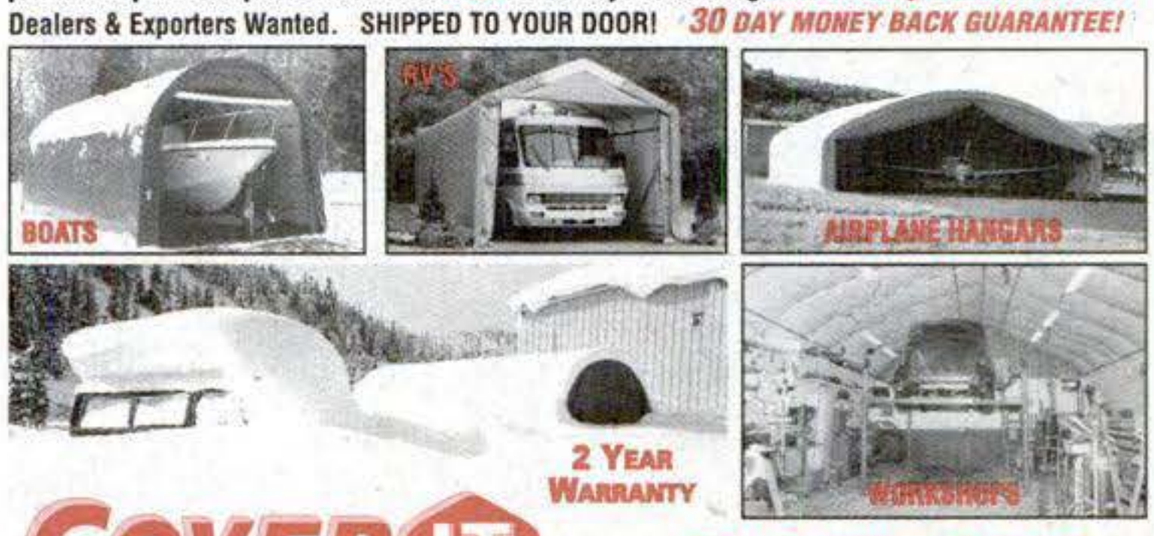

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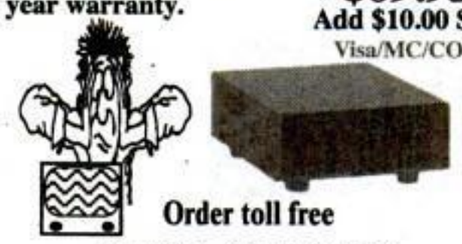

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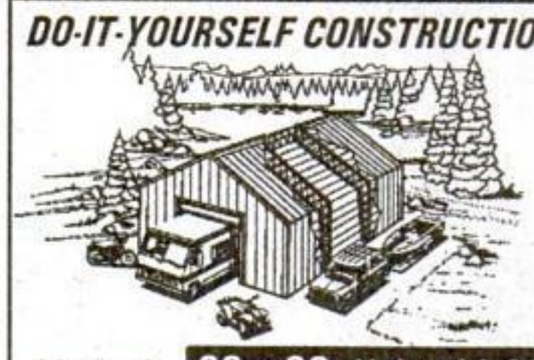

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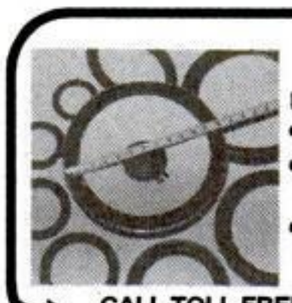

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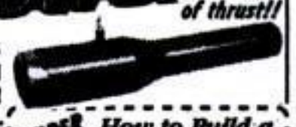

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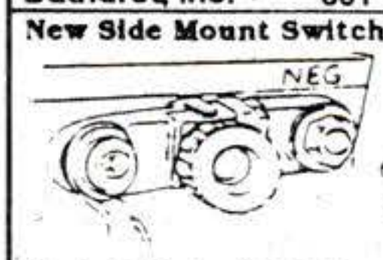

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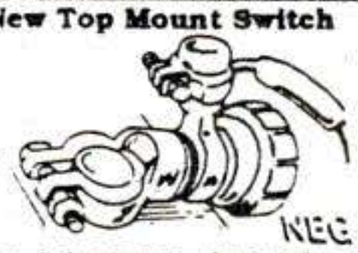

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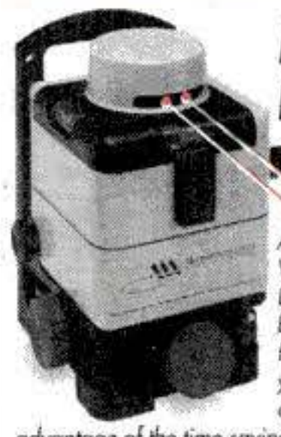

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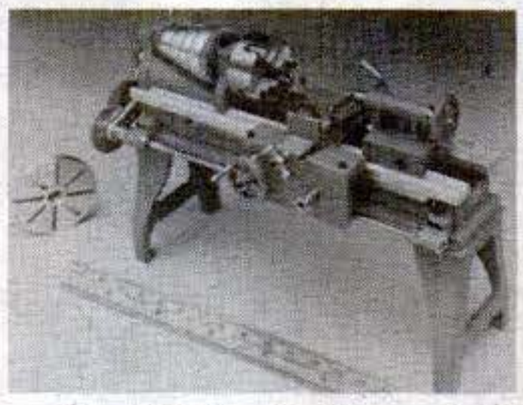

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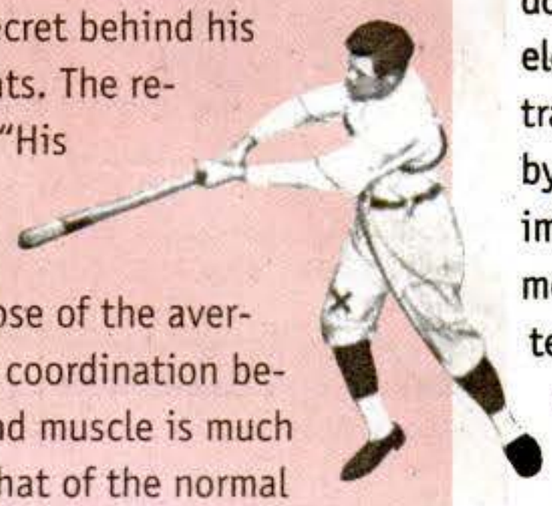

POPULAR SCIENCE *tested Ruth after his first outbursts of power in 1920 and 1921; previously, the Babe starred as a pitcher. His long-standing 1927 record of 60 round-trippers was well ahead of him. The researchers concluded that efforts on the mound had interfered with his home-run power, because "pitching and studying batters disturbed his almost perfect concentration."*

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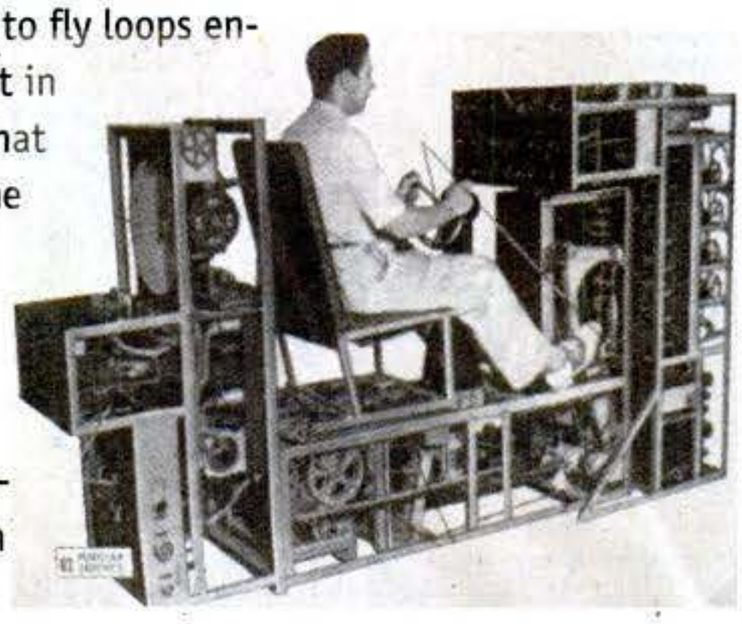

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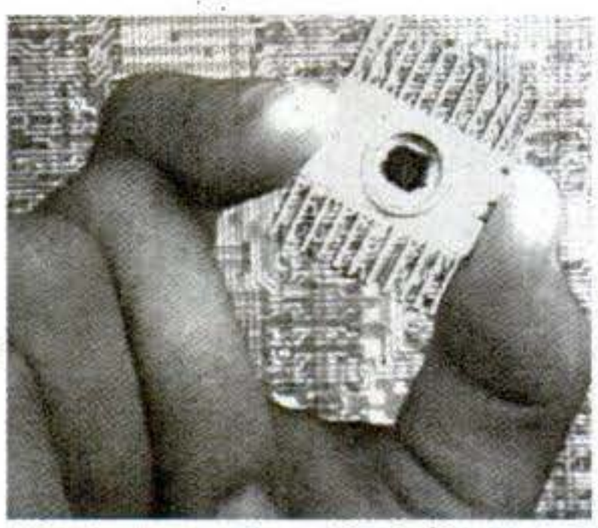
Large-scale Integration

25 YEARS AGO GET READY FOR AN INCREDIBLE change in semiconductor complexity: large-scale integration on match-head-size silicon chips (one of which is magnified below). Calculators with the technology are already here. Sophisticated terminals and other digital systems for your home and car will be among the new gadgetry. A data-transmission center and display for the home will be similar to units now used with large digital computers. The display will look like a cross between an electric typewriter and a TV set.—*October 1971*



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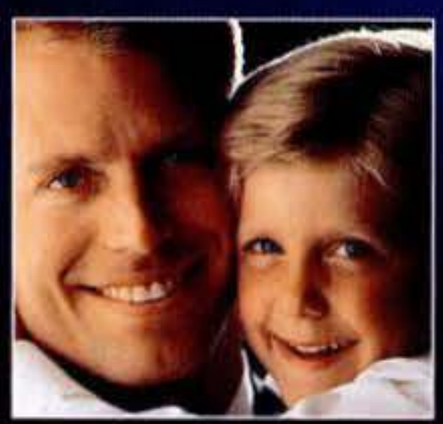

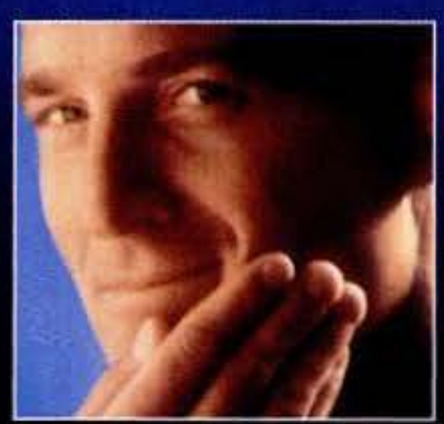

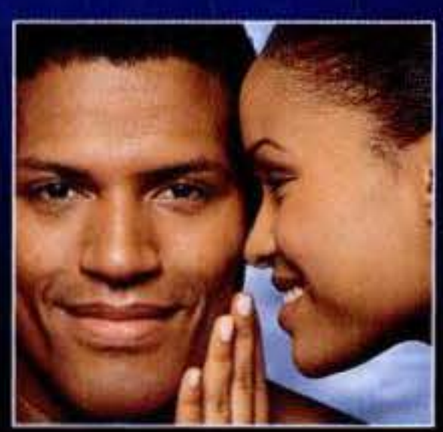

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